NATURE

Vol. 141 SATURDAY, APRIL 9, 1938 No. 3571

CONTENTS

	PAGE
Blood and Soil	621
Health Services of Great Britain	624
Organo-metallic Compounds. By W. H. M.	625
Descriptive Zoology	627
Scientific Work of the Drifting North Polar Station. By P. Shirshov and E. Fedorov	629
Oil from Coal. By Prof. C. H. Lander, C.B.E.	632
Archæological Discovery in Britain, 1933–38	633
Obituary Notice:	
Sir Harcourt Butler, G.C.S.I., G.C.I.E.	635
News and Views	636
Letters to the Editor:	
Resonance Transmutations of Carbon by Protons.—P. I. Dee, S. C. Curran and V. Petržilka	642
The λ-Phenomenon of Liquid Helium and the Bose-Einstein Degeneracy.—Dr. F. London	643
Cross-Sections of the Deuteron for the Electric and Magnetic Nuclear Photo-effect.—Dr. Hans v. Halban, jun.	644
Wilson Chamber Study of the Neutro-Electric Effect.—Seishi Kikuchi and Hiroo Aoki	645
High-Pressure Afterglow in Nitrogen.—Prof. Joseph Kaplan	645
Effect of Catastrophic Ionospheric Disturbances on Low-Frequency Radio Waves.—R. Bureau	646
Vitamin E: Structure of β-Tocopherol.—Dr. F. Bergel, A. Jacob, A. R. Todd and T. S. Work; Dr. J. F. Danielli	646
Function of Carbon Dioxide in the Metabolism of Heterotrophic Cells.—Dr. J. W. Hes	647
Dissolving Action of Micro-Organisms on Milk-Wool.—Prof. Jan Smit and B. van der Heide	647
Activity of the Sheep Tick.—Prof. James Hendrick, Walter Moore and Guy D. Morison	648
Tube Formation in *Pomatoceros triqueter* (L.).—J. D. Robertson and Dr. C. F. A. Pantin, F.R.S.	648
Relation between Structure of Pine Leaves and their Position on the Tree.—Prof. M. Moissejewa	649
Blood Groups of the Noluas of Bengal.—Dr. M. N. Basu	649
"Clay".—Sir William Bragg, O.M., K.B.E., P.R.S.	649
A Shortened Method of Estimation of Mental Factors by Regression.—Dr. Walter Ledermann	650
Research Items	651
Teaching of Technical Optics	654
Inauguration of the German State Council for Research	655
Medical Research in Canada	656
Progress in Road Research	657
Water and the Plant	658
Telegraphy and Telephony	658
Science News a Century Ago	659
University Events	660
Societies and Academies	660

Editorial and Publishing Offices:
MACMILLAN & CO., LTD., ST. MARTIN'S STREET, LONDON, W.C.2.
Telephone Number: Whitehall 8831 Telegraphic Address: Phusis, Lesquare, London
The annual subscription rates are: £2 12 0 British Isles, £2 17 0 Foreign, payable in advance

Advertisements should be addressed to
T. G. Scott & Son, Ltd., 63 Ludgate Hill, London, E.C.4. Telephone Number: City 4211
Registered as a Newspaper at the General Post Office
All rights reserved

CAMBRIDGE

A new volume in the *Cambridge Series of Physical Chemistry*

COMBUSTION, FLAMES AND EXPLOSIONS OF GASES

By B. LEWIS and G. von ELBE. *21s. net*

The interest in combustion phenomena, shared alike by chemists, physicists, and engineers, has led to a large number of investigations which vary widely in purpose and accomplishment as well as in actual scientific value. The need was for co-ordination and critical appraisal of these recorded investigations. This is the first purpose of the present book. Secondly, believing that well-founded speculation has great value as a stimulus to further research, the authors have not hesitated to express rather definite views on some highly controversial subjects.

INTUITION

By K. W. WILD *10s. 6d. net*

Miss Wild looks into contexts that have the authority of great names or of accepted usage to see whether or not the idea behind the word can be deduced. If she does not settle the question, she shows the problem with a new clarity, the possible answers, and a way by which, perhaps, the right answer may at last be found.

UNIVERSITY PRESS

★ First-Class Qualifications for Laboratory and Field

Superfine grain . . . high resolution . . . these, the first desiderata in sensitive material for scientific photography, are to be found working hand in hand with full panchromatism and a true scale of gradation in

KODAK 'PANATOMIC' FILM

An anti-halation backing equips 'Panatomic' to deal faithfully with delicate highlight detail, and its great latitude, due to double emulsion coating, enables contrasty lighting effects to be scrupulously rendered.

On every count, 'Panatomic' is a thoroughly fine all-round film for laboratory and field use with any type of camera.

Available in Roll Films, Film Packs, Cut Films, 35mm. Cassettes and Unspooled Lengths.

The fine-grain characteristics of 'Panatomic' Film are still further enhanced by the use of Kodak *Ultra Fine Grain* Developer—specially prepared to reduce granularity in photographic emulsions to a minimum.

Write for details and prices to

KODAK LTD · KODAK HOUSE KINGSWAY · LONDON · W.C.2.

Editorial & Publishing Offices :
MACMILLAN & Co., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

Telegraphic Address :
PHUSIS, LESQUARE, LONDON

Telephone Number :
WHITEHALL 8831

Vol. 141 SATURDAY, APRIL 9, 1938 No. 3571

Blood and Soil

THE history of mankind is largely a story of the conflict of man's ideals, or, as the cynic would say, of his illusions. Of these the most potent, and in the long run the most enduring, are those affording the herd instinct fullest opportunity for play. This instinct, binding individuals by a bond of brotherhood in communities armed at all points for attack and defence, is at once self-regarding and altruistic. Appealing to both sides of human nature, in the struggle for existence it is the most effective of all the means of survival.

Among manifestations of the herd instinct the concept of 'race' has played a greater part in the development of modern civilization than any other factor, except perhaps religion. It is capable of wide extension ; and on occasion it over-rides the closest and most intimate ties, even, paradoxically enough, those of the family, from which it takes its origin. For the apotheosis of 'race', which is the very heart of the aggressive nationalism of modern Europe, derives the strength of its appeal, not so much from tribal origins, as from the blood-call which goes back to the intimate association of the primitive individual family and its blood-relationship. It is this tie which by a process of enlargement provides the binding force and the emotional colour in the progression of social organization from family to kin, tribe, people and nation ; and when transferred from the group to the territory it occupies, is capable of inspiring the noblest self-sacrifice and deeds of the loftiest patriotism. Cultural association and religious tradition undoubtedly play their part ; but the ever-recurrent theme is the blood-tie.

Recent events in Central Europe have demonstrated how the racial idea could add dynamic force to a political movement for which neither historic tradition nor economic advantage had inspired adequate enthusiasm. In his speech before the Reichstag on March 18, Herr Hitler, reviewing the course of events of the preceding week, described the incorporation of Austria in the German Reich as "a racial triumph", and the culmination of a movement of "national-thinking people—to set up in place of a lying democratic violation of a people, the more holy rights of the eternal racial life". The sanctity of the racial life is to be further impressed on the population by the extension forthwith of German racial legislation to Austria.

To those who hold to the ideal of individual liberty and freedom of thought as the fundamental principle in intellectual and social progress, though they may admit the dynamic force inspired by a thoroughgoing acceptance of the racial idea, the intolerance, arrogance and injustice apparently inseparable from the discriminations of racial doctrine, when harnessed to political action, are wholly repugnant. What could be more significant as an example of the repression of individual judgment and the arrogant assumption of a right to eliminate the free expression of opinion, than Dr. Goebbels' own words, commenting on the statement that criticism was not allowed in Germany. They had no objection to criticism, he said, but it must be criticism from the superior to the inferior (*The Times*, March 23).

Germany does not stand alone. Wherever in social contacts discrimination has been imposed on the basis of racial groupings or the colour line—purely physical distinctions, be it said—these distinctions are made, unjustifiably, an imputation of innate inferiority, both intellectual and moral, in the excluded race or group. So it is said by a member of a people so highly race conscious as

the Japanese, "From the fact of the divine descent of the Japanese people proceeds their immeasurable superiority to the natives of other countries"; thus the scholar Hirata, while the learned publicist, Dr. Uesugi Shinkichi, holds "it is now most clear that the salvation of the entire human race is the mission of our Empire".

Aryan doctrine perhaps has not yet gone so far as this except by implication, though its upholders maintain that all progress in civilization has been the work of the Aryans, of whom the German people as Nordics are the characteristic modern representatives. No student of European prehistory and ethnology, outside Germany, could endorse this claim. It is not known either that the Aryan-speaking peoples were racially homogeneous, all conforming to the Nordic type, nor would it be accepted as probable that a nomad pastoral people, such as the Nordics on their first appearance on the scene, were pioneers of a higher culture, when they impinged, for example, on the Minoan civilization of the Mediterranean, or the 'Dravidians' of India.

The discussion of innate racial superiority and inferiority in mental character is bootless. Too little is as yet known of racial psychology to justify a correlation of mental and physical characters, which would warrant the imputation of mental and moral superiority or inferiority in certain types of physical make-up. Even difference in cultural level—the state of backwardness—has yet to be shown to be a sign of inferiority in innate intellectual calibre. Investigation, so far as it has gone, affords no sufficient ground for the conclusion that 'primitive' peoples are intellectually stunted, even though their mental processes are environmentally conditioned; and it would be difficult to accept any assumption of inferiority where the members of the two racially contrasted groups have grown up and lived in an identical cultural environment, as have most of the Jews who have been expelled or excommunicated of late years in Central Europe. Even if, however, it were possible to correlate certain types of mental character with racial characters, the doctrine, if carried to its logical conclusion, demands purity of racial type, which, indeed, German policy would now seem to regard it as its aim to make coterminous with 'nation'. But most anthropologists hold the 'pure' race a fiction, while 'the racial type' in this context can only be regarded as an ideal, towards which peoples are continually evolving. This is apparently the view of Sir Arthur Keith, when he maintains that a race is a nation in the making. Even in Germany, however, though the extent of the broad-headed element has been consistently minimized, the existence of mixed types has always been admitted; while even recently it has been advanced that a blonde pigmentation is not an essential criterion of Aryan descent. In fact, in the theory of a pure Aryan race, of which the Germans are the descendants, Nazi doctrine appears to have slipped into the familiar fallacy of translating the ideal at which it aims into a pseudo-historical fact of the past.

To be of any scientific value, 'race' as an entity must be susceptible of exact definition; but anthropologists are by no means agreed as to the criteria and precise value of the term. That there are such differences in physical character and appearance between individuals as to afford a strong presumption of ancestry and origin, and, therefore, in that partial sense racial, is a matter which, as Sir Arthur Keith is fond of pointing out, can be verified by anyone who walks down the street. If, however, an attempt is made to analyse the basis of this judgment, more often than not it will be found to depend to a large extent upon colour, primarily of the skin, then of hair, and then eyes. An entertaining and instructive exercise is to imagine a white skin on some of our darker fellow-subjects encountered in street and train. It is surprising to find how often even an African might in feature pass for European, if the lips are not too thick. Yet there may be nothing to suggest European admixture. At the same time the Mongolian fold over the eye usually betrays the eastern Asiatic; yet occasionally it is found with other Mongolian facial characters in Europeans, both normal and abnormal.

On one fact anthropologists are agreed. Modern man belongs to one species, *Homo sapiens*, and that in this species are many varieties, or races, but that none of these can now be regarded as 'pure'. For purposes of classification and analysis, these varieties are grouped in terms of type, according to physical characters recorded by measurement and descriptive observation; but these racial types are abstractions for methodological convenience. When this type classification is applied to observation in the field, it is found that any given group no more than tends to conform to type within a certain range of variation. In effect, man is the most variable of all animals. The most that can be said of the races of man is that within the range of his variation at certain

points certain physical characters show a tendency to become dominant, forming a nucleus, which for purposes of convenience is regarded as a racial type.

It by no means follows that this type is either universal within its area, or confined to it. In Europe, for example, Nordic, Alpine, Mediterranean may be the dominant types within the regions from which they take their respective names, but they are inextricably intermingled in varying proportions throughout the whole continent. Nordics and Alpines appear in Mediterranean lands, dark and broad-headed among the long-headed, blonde Scandinavians. For from the dawn of civilization, Europe has been swept from end to end by racial migrations and invasions, which have left their legacy in an inheritance of fused racial characters, while in modern times facilities of transport and a freedom of intercourse in international relations have further tended to confuse the geographical distribution of physical type and racial distinction. In these conditions the racial type becomes a theoretical postulate and purity of race a claim without counterpart in fact. Nor do these conditions prevail in Europe alone. Ever since time began, man's wanderings and his conquests have tended to obliterate distinctions which isolation, inbreeding and tribal prejudice promoted and preserved, until only broad distinctions remain valid.

Acceptance of the strict biological view of race and the inheritance of physical characters in man does not preclude recognition of the patent fact that there are differences, some of them considerable, between the national and other local groupings of man which afford ostensible support for nationalist doctrine; but they are due to environmental conditions rather than a physical inheritance. If, moreover, in physical character modern man is specifically one, it is no unfair assumption, unless due cause is shown to think otherwise, that in mental character man is also one, and that underlying cultural differences, which can be shown to be due to environmental and historical causes, there is a psychic unity, which can at need transcend nationalist and other separatist influences. In science, for example, man speaks a universal language and joins in a world-wide activity.

It is evident that in the development of the social organism from the primitive horde or individual family to the nation, the differences between local and other groupings have been subordinated to such elements as they have in common, in order that other groups, ever increasing in size and complexity, may be formed, in which, when once internal harmony has been established, the good of the whole may be pursued. Out of such groupings for a common end the modern civilized nations have arisen; and there is no inherent reason, so far as scientific studies of the growth of societies would go to show, why development should come to an end at the point which it has now reached. There have been, in fact, in recent years two experiments in carrying development further. Of these one is the British Commonwealth of Nations, which has still to be submitted to a crucial test, the other the League of Nations, which, apart from its more widely advertised political action, has done a great work in science, economics and social reform for the advancement of the interests of mankind at large. In these fields of its activity, racial and national differences have proved no bar to co-operation, even though the time is not yet ripe for the joint political action which it was hoped that the League would promote. It is to some such larger unity that the scientific analysis of the history of human associations would appear to point as the goal of the future, rather than to an antagonism of rival national or racial entities, engaged in a struggle which belongs more properly to a pre-social stage of development.

In its origins science is one form of the response to man's eternal quest for law and order in the universe; but from the earliest times it has also served his material needs. When primitive man first observed the ordered movement of the stars, it was not so much in satisfaction of a divine curiosity, as from the desire to arrive at some such law of seasonal progression as would enable him so to order his life as to ensure the proper care of flocks and herds and the sowing and harvesting of his crops; and so in the world of modern civilization. Knowledge may be pursued for its own sake, but it is no less the function of science to share in that planning for the future, which the development of social and economic organization makes more and more imperative every day. If, however, the study of man, his kinds and varied modes of life is to contribute to the solution of our problems, as it is only reasonable to anticipate, it must be as a study based on impartial and objective observation of fact, and not the forcing of fact to fit a biased and distorted political dogma born of fear and hatred—a science travestied in masquerade.

Health Services of Great Britain

Report on the British Health Services: a Survey of the Existing Health Services in Great Britain with Proposals for Future Development. (P E P (Political and Economic Planning).) Pp. iv + 430. (London: Political and Economic Planning, 1937.) 7*s*. 6*d*. net; cloth, 10*s*. 6*d*. net.

THIS large and heavy book of 430 quarto pages, said to contain 200,000 words, is described by its anonymous authors as a survey of the existing health services in Great Britain, with proposals for future development. The writers constitute an independent, non-party group of industrialists, distributors, local government officials, medical men, university teachers, and so forth, "who give part of their spare time" to social and economic studies, and issue fortnightly 'broad-sheet' plannings.

Early in the nineteenth century, the sanitary services of Great Britain were strengthened and invigorated by the introduction, and ultimately the Parliamentary imposition, of what have come to be known as 'special medical services'. It was a new factor or method of dealing with the national ill-health. Speaking generally, it began with the Poor Law medical service, originating in the Elizabethan period, and that deeply instructive movement led on to factory and workshop reform dating from 1802, to the registration of births and deaths, vaccination, and official inquiries into the causes of epidemic disease. It found legislative expression in a long series of Public Health Acts, the development of 'the sanitary idea' and the beginnings of a 'sanitary conscience'. It was Disraeli who coined his party's watchword, *sanitas sanitatum et omnia sanitas*; and it was Sir John Simon who gave us the classic record of the administrative rise of "English Sanitary Institutions" in 1890.

The foundations of all the British health services were laid before the present century opened, yet it was not until after the great Education Act of 1902 that they took their present form, the form which is discussed in this volume. But there can be no wise or mature consideration of their existing basis or purpose without a historical understanding of their origin. In our own day, and particularly since the Liberal Government of 1906, there has been wide and rapid growth of these services. The feeding and medical supervision of school children, maternity and child welfare, old age pensions, health insurance—with 19,000 panel doctors and nineteen million insured persons—a vastly enlarged hospital service (voluntary and municipal), industrial health, a reorganized medical profession, medical education, dentists, official midwives, nurses, sanitary inspectors, physical education, organized research—all this is novel and in the early process of initiation and administration.

No responsible body has previously attempted the very formidable task of showing how these services work, are co-ordinated, and can be conjunctly developed. This compilation furnishes a mine of important and interesting information, derived in the main from official reports, local and central. It is an encyclopædic summary, made lively by numerous criticisms, not all equally valid or well conceived. Indeed, occasionally it would appear that the writers would greatly enjoy the task of re-creating *ad hoc* the growth of two centuries, not only of Parliamentary legislation but also of the will and education of the English people. In which case it may be added that they are not alone, in Great Britain or in Russia.

More than fifty years ago, one of our foremost statesmen, trained in a long experience of the diplomatic service, reminded us that the basis of all government and the object of all statesmanship must always be *expediency*—that which is, on the whole, best for the entire community. He urged that the test of statecraft is not truth or falsehood, but good or evil. All political action, in his view, was good or bad, right or wrong, according to its consistency not with theory but with *circumstance*, and such circumstance is not simple, uniform, general or consistent, but infinitely varied, fluctuating and divergent. We cannot, he said, apply to courses of political action or administration the methods which are properly applicable to trains of reasoning, for the object of the latter is to arrive at abstract truth, of the former to bring about concrete good of a particular kind for a particular multitude of human beings, whose condition is extremely composite and whose interests are rarely identical. "Government", he believed, "is neither more nor less than the trustee or guardian of the collective interests of a State. Institutions are not made, they grow, not logical, simple or symmetrical, but various, intricate and full of salutary anomalies". Hence in a general review of statecraft it is prudent to proceed with caution, and have regard to history, experience, circumstance and expediency; and, especially when dealing with the administration of science and the scientific method, to keep in mind the existing state of science itself.

This summary of the existing health services of Great Britain, official and voluntary, is the best we have seen, and its compilation ought to serve and assist all who are actively concerned in actual administration. It is unfortunate, perhaps, that it is inadequately documented and lacks a bibliography. The reader is left with a large volume by an anonymous, and apparently self-appointed, group of zealous students, and without reference to the sources of information. The book itself is clear evidence of the competence of its writers and the reader is assured of the authenticity of their resources. We rather agree, however, that such a survey should have been undertaken by an officially appointed or approved body, and not anonymously. Its appeal is mainly to the local authorities and their officers, who are accustomed to the English practice of signed reports by responsible persons. But in any event, here is a book which provides the reader and student with a most valuable, instructive and comprehensive presentation of the facts.

For the reason just mentioned, and for other obvious reasons, including finance, we fear the numerous recommendations and proposals made throughout the report, many of them acutely controversial, are less likely of acceptance. The public will naturally consider the suggestions regarding the medical profession as a matter primarily for its members, through the General Medical Council and the British Medical Association; midwives, nurses and dentists have also quite recently received much Parliamentary attention; nutrition and physical education are, it is to be hoped, fairly on the way to reform; the various suggestions for the improvement of health insurance have already been before a Royal Commission; and some of the more abstruse medical problems await further knowledge and experience.

We welcome the interest of the writers in the importance of medical research. Certainly, there is always need of more knowledge. Yet in a single generation we have witnessed, at any rate since 1911, a great awakening and an ever-extending appreciation of that need. The fundamental difficulty is lack of researchers, for true research can only be done by those who have the talents and experience which especially fits them for it. Often, the indirect approach is the more effective; the human body is immeasurably complex and all sciences affect the issue, which is rarely medical only. Physics, statistics, biology, geology, may be as material as physiology or pathology, and the relation of the sciences to each other and to the whole is highly relevant to the acquisition of more knowledge. Facility and opportunity—ways and means and money—are rapidly becoming more available. New and further knowledge cannot be gained by pressure or administrative organization. Even now much scientific knowledge awaits application rather than elucidation. Nor is there any doubt that it is common knowledge among responsible officers in the health services that health and ill-health bear intimate relation to social condition, economics and psychology, and this is now more appreciated than formerly.

Organo-metallic Compounds

Die Chemie der metall-organischen Verbindungen

Von Prof. Dr. Erich Krause und Prof. Dr. Aristid von Grosse. Pp. xvi + 926. (Berlin: Gebrüder Borntraeger, 1937.) 55.20 gold marks.

FROM the time of their discovery, the organo-metallic compounds have aroused particular chemical interest. The manner in which they were first encountered was dramatic. Edward Frankland, working in Bunsen's laboratory in 1849, was attempting to isolate the radical methyl by heating methyl iodide with zinc in a sealed tube. "After discharging the gases" he says ("Sketches from the Life of Sir Edward Frankland", p. 186), "I cut off the upper part of the tube in order to try the action of water upon the solid residue. Upon pouring a few drops of water upon this residue, a greenish-blue flame, several feet long, shot out of the tube, causing great excitement in the laboratory. Bunsen, who had suffered from arsenical poisoning during his researches on cacodyl, suggested that the spontaneously inflammable body might be that terrible compound formed by arsenic present in the zinc as an impurity, and that I might be already irrecoverably poisoned."

Fortunately Bunsen was wrong. The inflammable compound was not cacodyl but zinc methyl, and Frankland survived the incident by more than fifty years. The discovery of the alkyl compounds of zinc was quickly followed by that of similar derivatives of mercury, tin and antimony, and consideration of these substances led Frankland to make his great contribution to chemical theory—the law of valency.

At the beginning of the present century, two events gave a powerful stimulus to the investigation of organo-metallic compounds. These were

Grignard's discovery in 1900 of the organo-magnesium halides, and that of Ehrlich in 1907 of salvarsan. The extraordinary value of the Grignard compounds as synthetical reagents led to their exploitation in all possible directions and brought notable advances in many fields of organic chemistry, whilst Ehrlich's discovery laid the foundation of the new science of chemo-therapy, and by inspiring the search for new therapeutic agents led to an active investigation of the organic derivatives not only of arsenic but also of mercury and antimony. Of some 12,000 known organo-metallic compounds, about 8,000 are derivatives of arsenic.

The most abundantly utilized organo-metallic compound is lead tetraethyl ('Ethyl'), on account of its 'antiknock' properties discovered by Midgeley in 1922. More than 70 per cent of the petrol consumed in the United States for automobile propulsion in 1936 had received an addition of lead tetraethyl, and the annual consumption of this compound in the U.S.A. alone amounted to some 20,000 tons. In Germany, however, iron pentacarbonyl ('Motalin') is chiefly employed as an antiknock.

Of the purely scientific applications of organo-metallic compounds probably the most striking is that made in Paneth's work on the thermal decomposition of the alkyl compounds of lead and bismuth, by which it was shown that the radicals methyl and ethyl are capable of independent though brief existence.

The book under review is a treatise of more than 900 pages. Organo-metallic compounds are defined as containing a metal linked by a principal valency to the carbon of a hydrocarbon radical. Co-ordination compounds are thus excluded, but arsenic and tellurium are counted as metals and the alkyl compounds of oxygen, sulphur and selenium, and of the halogens, nitrogen and phosphorus are shortly described for comparison.

The derivatives of the four elements the organic compounds of which have been most extensively investigated—magnesium, mercury, arsenic and antimony—are treated in considerable detail (for example 143 pages are devoted to arsenic compounds) but are not dealt with exhaustively, since this is naturally impracticable within the limits of a single volume (and the authors suggest that it is the less necessary since excellent monographs dealing with these elements are already available.) They claim, however, that of the remaining metals, all known compounds are included so far as they appear in the literature abstracted in the *Chemisches Centralblatt* down to January 1, 1936.

Physical data are fully recorded, but the authors deplore that the only properties which have been hitherto at all extensively determined are boiling points, melting points and densities. They point out that the alkyl compounds of the elements, providing a series of mostly normal liquids, free from disturbing effects of association and co-ordination, form material of exceptional value for the study of the variation of the combining properties of the elements over wide regions of the periodic table, and they stress the desirability of obtaining more complete data derived from the newer methods of investigation (for example, Raman spectra, at present available only for limited groups) in order to enable a general comparison of the more fundamental properties of the links which the elements form with alkyl groups.

A chapter is devoted to theoretical considerations on the organo-metallic compounds. Of the ninety known elements, only about forty form alkyl derivatives. The transition elements lack the power of combining with hydrocarbon radicals, for of the forty-two elements of this category only two—platinum and chromium—have been definitely found to yield alkyl or aryl derivatives. The authors correlate this with the fact that the transition elements, unlike other elements, have their valency electrons distributed between two principal quantum groups. In titanium, for example, which forms no organo-metallic derivatives, two of the four valency electrons are in the *M*- and two in the *N*-shell. To explain the incapacity of such elements to combine with hydrocarbon radicals, the authors suggest that when the valency electrons are in two principal quantum groups, those with the lower principal quantum number yield antibonding molecular orbitals. This explanation is conceivable, but scarcely probable. The transition elements differ from other elements in having *d*-electrons among their valency electrons, and it may be that the character of the *d*-wave functions is such that they do not combine with *s*-wave functions to give bonding orbitals of the necessary strength. In any event the explanation is likely to be more subtle than that suggested.

The descriptive parts of the book are well and clearly arranged, and the experimental aspects of the subject receive special attention. Detailed directions are given for the preparation of representatives of the chief types of organo-metallic compounds, and a number of devices are described that have been found useful in the manipulation of substances which, like so many members of this class, are specially sensitive to atmospheric oxidation.

This treatise is to be commended as a book of reference which should prove most valuable to all workers in the field with which it is concerned.

W. H. M.

Descriptive Zoology

Handbuch der Zoologie:
eine Naturgeschichte der Stämme des Tierreiches. Gegründet von Prof. Dr. Willy Kükenthal. Herausgebenen von Dr. Thilo Krumbach. (Berlin und Leipzig: Walter de Gruyter und Co., 1937.)

(1) Band 3, Hälfte 2: Chelicerata, Pantopoda, Onychophora, Vermes Oligomera. Lief. 10, Teil 5. Pp. 7–134. 18 gold marks.

(2) Band 3, Hälfte 2: Chelicerata, Pantopoda, Onychophora, Vermes Oligomera. Lief. 9, Teil 2. Pp. 289–384. 12 gold marks. Band 3, Hälfte 2: Chelicerata, Pantopoda, Onychophora, Vermes Oligomera. Lief. 11. Pp. 385–496. 16 gold marks.

(3) Band 5, Hälfte 2: Tunicata. Lief. 6. Pp. 545–672. 18 gold marks.

(4) Band 6, Hälfte 1: Acrania (Cephalochorda) = Cyclostoma, Ichthya. Bearbeitet von Dr. Victor Pietschmann. Lief. 5. Pp. 449–560. 14 gold marks.

(5) Band 7, Hälfte 1: Sauropside, Allgemeines; Reptilia; Aves. Lief. 3. Pp. 225–320. 14 gold marks.

(1) THIS well-known general "Handbuch der Zoologie" revives the term Vermes, which has practically ceased to be used in English texts. The Vermes are divided into three groups, the Amera, Polymera and Oligomera. The present part is the first of the section of the book to treat of the Oligomera. This group includes three classes: (1) Tentaculata, that is, the Phoronidea, Bryozoa and Brachiopoda; (2) Sagittoidea (Chaetognatha); and (3) Brachiotremata, that is, the Pterobranchia and Enteropneusta. The first sixty pages contain an introduction to the Oligomera, including a bibliography of general works. The next four pages are an introduction to the Tentaculata in particular, and the last sixty-four pages furnish a complete and most useful account of the Phoronidea up to the first few items of the special bibliography of that group. The whole part contains 150 well-produced figures, a good number of which are original. A curious error has crept in on p. 123. No. 24, *Phoronis pacifica* is correctly stated to be Puget Sound and Humbolt Bay, but on the map point 24 is depicted on the east coast a little south of New York.

(2) Part 9 of this half of the second volume contains 116 illustrations. The first eleven pages conclude the account of the Solifugidæ by A. Kästner and are mainly concerned with the distribution, classification and literature of the group. Ten families in all are recognized and defined, and a useful key for separating them is provided. The bulk of the part is concerned with A. Kästner's account of the Opiliones, up to their geographical distribution.

The first nine pages of Part 11 carry on from Part 9 and conclude the Opiliones. It contains little more than a review of the families and subfamilies, among which the more than 1,400 species of the order are divided, and the list of the relevant literature. The remaining hundred and three pages commence the account of the Araneæ, or true spiders, by U. Gerhart and A. Kästner. It deals in detail with the general morphology, anatomy and histology of the group up to the beginning of the female reproductive organs—the reproductive system being the last to be considered. The part is illustrated with 133 figures, a number of which are original.

(3) In Part 6 of the second half of the fifth volume Dr. Johan Huus deals with the Ascidiaceæ or simple Ascidians. It contains 123 figures, mostly, with the exception of the distributional maps which are original, chosen from the works of previous writers. It completes the account of the structure, physiology and ecology of the sub-class and also a large part of the systematic review of the genera, but does not include the bibliography.

(4) The first hundred and two pages of the first part of volume 6 complete the account of the Cyclostoma by Dr. V. Pietschman. It has thus taken five hundred and fifty pages and 531 figures altogether to deal with this group. Without in any way suggesting that it is an uninteresting or unimportant group, it would seem that such treatment exceeds in length and detail what is usually expected of a "Handbuch". In itself it forms quite a substantial volume, and the various parts together cost 68 gold marks. It is obviously impossible to treat all the groups of the animal kingdom at this length. As it stands, it forms a veritable mine of information and has a most useful bibliography. The last ten pages commence the general account of the Ichthya or true fishes.

(5) The first eleven pages of this part conclude Proj. O. von Wettstein's account of the order Rhynchocephalia. It is naturally based on the genus *Sphenodon*, of which only one living species, *punctatus*, is recognized, although several varieties are described. Brief reference is made, however, to the allied fossil orders, Choristodera and Rhynchosauroidea. The whole account of the order occupies two hundred and thirty-five pages, is illustrated by 174 figures, and terminates with a most useful and full bibliography. The remainder of the part deals with the Crocodilia.

Economic Botany:
a Textbook of Useful Plants and Plant Products. By Albert F. Hill. (McGraw-Hill Publications in the Agricultural and Botanical Sciences.) Pp. x+592. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 24*s*.

IN this work, the author, who is research assistant in economic botany at Harvard University, deals in an interesting manner with the more important useful plants and plant products of the world from the point of view of their history, cultivation, preparation and utilization. He shows how the three great necessities of life—food, clothing and shelter—as well as a large number of other useful products, are supplied in great measure by plants. Economic plants have been intimately bound up with human existence and have not only played an important part in the everyday life of mankind but have also had a profound influence on the course of history and civilization. Spice plants and the early spice trade afford evidence of this.

The volume consists essentially of four main sections: industrial plants and plant products; drug plants and drugs; food plants; and food adjuncts. Under the first of these are fibres, forest products and resources, tans and dyes, rubbers, gums and resins, essential oils, fatty oils and waxes, sugars, starches and cellulose products. Food plants include cereals, legumes, nuts, vegetables, fruits, spices and beverage plants. Insecticides such as pyrethrum, derris and cube (*Lonchocarpus*), which have assumed increasing importance in recent years, are also dealt with. In all, about eight hundred species are referred to, greater stress being laid on those plants that are of particular importance in the United States. There are numerous photographs in the text, and a full index and bibliography of more important works are given.

Introduction to Theoretical Seismology
By J. B. Macelwane and F. W. Sohon. Part 1: Geodynamics. By J. B. Macelwane. Pp. x+366. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1936.) 30*s*. net.

AS the author remarks, "the forces producing earthquakes, the character and structure of the rocks affected, and the permanent displacements occurring in them are geological phenomena". They form the subject of seismology proper, and have been well described in Heck's recent work on "Earthquakes" (see NATURE, March 27, 1937, p. 529). The subsequent course of the waves so produced and the physical properties of the media through which they pass form a distinct branch of science to which the present volume is devoted. Depending to some extent on older works, such as Galitzin's "Vorlesungen über Seismometrie", this book is a summary of lectures delivered by the author. With its companion volume on "Seismometry", by F. W. Sohon, it forms a text-book that will be of great value to students of geophysics.

In the first seven chapters, dealing with stresses and strains in elastic solids and the course of seismic waves through the earth, the treatment is almost entirely mathematical. The last four chapters are, however, of interest to the general reader. They describe the paths of seismic rays, the interpretation of seismograms, and, especially, the methods by which the positions of epicentres and the depths of foci are determined. Many useful tables are given, such as those of the velocities of waves in the different layers of the crust, the positions of important seismological stations, and the notation used in denoting the various phases that appear on a seismogram.

C. D.

Tables Annuelles Internationales de Constantes et Données Numériques:
International Annual Tables of Constants and Numerical Data. 14: Combustion and Detonation of Gases. By Prof. P. Lafitte. Vols. 11–12 (Years 1931–1936), Section 70. Pp. iii+28. (Paris: Hermann et Cie.; New York: McGraw-Hill Book Co., Inc., 1937.) 16 francs.

THE summary of constants and data relating to the combustion and detonation of gases contained in vols. 7, 8 and 10 of the "Tables Annuelles Internationales de Constantes et Données Numériques" has been brought up to date by Prof. Lafitte in vol. 14, which covers the years 1931–36. This period is noteworthy for many important advances in the subject, inspired to a large extent by Semenoff's development of the chain-reaction theory. Chain mechanisms of hydrocarbon combustion have been suggested by Egerton, Norrish and Lewis, and new phenomena indicative of chain processes have been discovered in relation to ignition, the limits of inflammability and detonation; in addition, there has been a general revision and extension of existing data.

Prof. Lafitte has used excellent judgment in assembling and summarizing the results of this large body of new information. The numerical data are tabulated or are given in the form of curves reproduced on a legible scale, and each of the ten sections into which the volume is divided is accompanied by a comprehensive bibliography. D. M. N.

Contes Lazes
Par Georges Dumézil. (Université de Paris: Travaux et mémoires de l'Institut d'Ethnologie, Tome 27.) Pp. xiii+134. (Paris: Institut d'Ethnologie, 1937.) 56.25 francs.

THIS collection of folk-tales from the Caucasus has a double interest. To that of the folk-lore content is added that of the linguistic material. The volume contains a collection of tales related to the author in Constantinople by a young Georgian, a native of Lazistan, in his own language. The themes, for the most part, are familiar, but the tales are told with a delightful naiveté. Some, as the author points out, probably have a literary origin. From the scientific point of view the chief value of the collection lies in the linguistic analysis of the little-known language of Lazistan. The author provides an interline, as well as a running, translation and a grammatical commentary.

Scientific Work of the Drifting North Polar Station*

By P. Shirshov and E. Fedorov

EXACTLY a year ago we were preparing for the press an article on the plans we had made for our scientific work on the drifting ice-floe. This article was published after the aeroplanes had landed us at the North Pole. It is pleasant to note that everything we had planned to do before we set out on our expedition has been done. Reality brought us much of the unexpected. In particular, the drift turned out to be more rapid than we had anticipated. In consequence, we were able to carry out observations at a considerably greater number of points than was originally planned. Over a distance of 15°—from the Pole to the 75th parallel—we carried out all the work we had set out to do. From February 1, after our icefloe had split, we were compelled to cease hydrological work, because the winch, which was kept about a kilometre from our tent, was carried away.

Owing to the rapidity of the drift, we were compelled to make more frequent observations than had been planned. To cope with the work was only possible because our colleagues—Papanin and Krenkel—relieved us of all domestic duties, which they took entirely upon themselves. Naturally, work like the measurement of the depths, rotatory and other observations, was carried out by the joint efforts of the four of us. Meteorological observations were carried out by Fedorov and Krenkel.

Every observation we made during the drift had to have an exact position. Therefore we endeavoured to determine our longitude and latitude as often and as carefully as possible. For these determinations we had to measure the height of the luminaries above the horizon. During the 274 days of the drift we took 534 series of measurements, from which we calculated our positions at 143 points. These points served as the basis for the entry of our course on the map. Up to the end of September, for astronomical determinations we made observations of the sun and sometimes of the moon. Later, when the oncoming darkness permitted us to see the stars, we always used the latter for our observations. Cloudy weather sometimes left us without a position for six or seven days at a stretch, but happily this did not often occur.

The study of the movement of the ice covering the surface of the Arctic Ocean was one of the most interesting subjects of our work. During the 274 days, we went from lat. 89° 26′ N. and long. 78° W. to lat. 70° 48′ N. and long. 19° 48′ W., covering 1,134 miles (1,800 kilometres) to the south-south-west (more precisely, a course of 197°) reckoning by the shortest line. The numerous zig-zags and loops, especially in the early days, actually lengthened our course, bringing it up to approximately 2,500 kilometres. Consequently, the average speed of drift of the icefloe was 9·1 kilometres or 5·6 miles a day. Though this was the average speed of our movement, actually the movement varied greatly. There were periods when for two or three days we remained on the same spot, and others when we drifted 23 miles (37 kilometres) per day.

The rapidity of the movement increased as we drew farther to the south. It became especially rapid towards the end of the drift, in January and February. For example, from the Pole to lat. 85° N. (from May to October) the average rate of movement was 2·7 miles a day. From lat. 85° to 80° N. (from October to January) the speed of the drift increased to 4·6 miles a day. In January the average speed had already risen to 11·5 miles, and in February to 12·3 miles a day.

What causes the movement of the ice in the region of the polar basin investigated by us? A preliminary examination of our observations shows that the ice drifts by the action of the wind blowing in a given spot; yet at the same time it has a continuous movement (directed in general to the south) which is independent of the local wind. Thus, in calm periods the ice moves to the south. A wind blowing from the north will speed up this movement. Southern winds will retard or even overcome it, and drive the ice to the north. The speed of the ice movement independent of the local wind was about a mile a day near the Pole. Farther to the south it gradually increased, reaching 5–7 miles per day between the 75th and 70th parallels.

On this systematic movement is superimposed the drift caused by the wind blowing in the given spot. The wind is powerless to draw the ice in the direction in which it is blowing. Preventing this is the law by which a body moving on the surface of the earth in the northern hemisphere is inclined to deviate to the right of the direction of its original movement. The ice, obeying this law, deviates to the right of the direction of the wind at an angle of about 40°. The speed of movement

* Received through the Soviet Union Year Book Press Service, 623-624 Grand Buildings, Trafalgar Square, W.C.2.

of the ice naturally depends on the velocity of the wind. It is interesting to note that their interaction—the "power of the wind to drive the ice"—was not uniform during the whole of our course. Near the Pole the wind drove the ice with a speed equal approximately to one- to two-hundredths of the velocity of the blowing wind. At the end of the drift the action of the wind increased in effectiveness.

What causes the movement of the ice southwards independently of the local wind? It seems simplest to assume the existence in the Arctic Ocean of a surface current which draws the ice. However, the rotatory observations, which will be dealt with in detail later, reveal the opposite. It is not the water which draws the ice, but the moving ice which draws after it the upper layers of the water. Evidently the general weather regime in the polar basin results in the prevalence of northerly and north-westerly winds (again we are calculating the direction in relation to the Greenwich meridian). These winds, predominating over a vast stretch, create a general flow of the ice towards the Greenland Sea.

Observations of currents arising in surface layers of the sea from the action of the drift of the ice were carried out by means of simultaneously lowering two rotators to different depths. The observations were made in series of five to six layers. Forty series of this kind were made. It appears that the ice draws only the uppermost surface layer of water. For example, with an ice-drift having a speed of 0·1–0·15 metre per second, the drift current is obvious at depths of 25–35 metres, and only on rare occasions does it affect the water down to 50 metres. The speed of the current decreases quickly with increasing depths. Whereas at a depth of 5 metres (two metres from the lower surface of the ice) the speed of the current fluctuates from 65 to 100 per cent of the speed of the drift, at a depth of 20 metres the speed of the current does not generally exceed 20–30 per cent of the speed of the ice-drift.

The drift current in the upper layers of the water sets in very quickly after the ice drift has begun, but it ceases as rapidly when the ice drift stops. A rapid and prolonged drift of the ice in any one direction draws after it a considerable quantity of water from the surface layer. An inflow of water follows from adjoining regions to replace it. A reverse current sets in to compensate for the movement of the surface waters from the given region. More often the reverse current is observable immediately underneath the surface layer of water drawn by the drift, that is, at a depth of 50–75 metres. However, during prolonged and rapid drifts, the reverse current embraces a considerably thicker layer, 35–125 metres.

In contrast to the drift current of the surface layer, the reverse current sets in after an appreciable lapse of time following the start of the drift of the ice—usually 12–36 hours. It reaches its maximum speed even later still, not infrequently only after the drift of the ice, which set the masses of water into motion, has ceased. Not infrequently, too, the reverse current continues for a long time, sometimes for several days, after the ice drift has stopped. For example, after a rapid drift to the south-east during August 10–13, the reverse current was observed at a depth of 75 metres up to August 19, that is, five days after the drift had ceased.

Measurements of depth were carried out by the help of a specially constructed deep-water hand-worked winch, equipped with a brake of the Lucas type. Altogether thirty-three observations were made, of which fourteen were at depths of more than 3,000 metres.

Starting from the Pole, up to lat. 86° 40′ our icefloe drifted over a deep hollow with an extremely sloping bottom of a depth of 4,300–4,400 metres. The greatest depth here appeared to be 4,395 metres (position lat. 88° 41′ N., long. 10° W.). Then the bottom commenced to rise—unevenly, with big jumps in depths, varying from 300 to 500 metres over a distance of 30 miles. In this region (up to the 84th parallel) the depths varied from 3,500 to 4,050 metres. At lat. 83° 56′ N., long. 0° 47′ E., we discovered a submarine elevation. The depth here was 2,380 metres. Farther on, from lat. 83° 30′ N. to 81° 50′ N., we again came to a depth of more than 3,000 metres. The greatest depth in this region exceeded 4,160 metres (lat. 81° 53′, long. 6° W.). The whole of the cable then on the drum was paid out but failed to reach the bottom. The existence of great depths in this region is of special interest in view of their proximity to Greenland. It was generally supposed that the depths here were those of the continental slope; actually there were deep hollows situated only forty miles from the North East Foreland.

The next measurement (at lat. 81° N., long. 6° 50′ W.) was carried out on the so-called Nansen threshold. The depth here was 1,420 metres. We know that it used to be supposed that here, between Spitsbergen and the North East Foreland, the sea bed rose to within a thousand metres of the surface, thus dividing the Arctic Ocean from the Greenland Sea. However, we maintain that the depth here is no less than 1,300–1,400 metres, and that, quite probably, the depths in the central parts of the Nansen threshold reach 2,000 metres.

In the Greenland Sea the icefloe drifted over the coastal platform. Here the depths were 160–250 metres, reaching 320 metres in one spot only.

Samples of the bed were taken at eight northern soundings with the aid of a scoop. The ground in the deep hollow of the polar basin is composed of oceanic silt of a reddish-brown colour. Under this layer of silt is grey silt. We have brought samples of these deposits with us for further analysis.

The thirty-eight hydrological soundings made by us during the period of the drift represent the two hydrological sections, from the 89th parallel to Greenland, and in the Greenland Sea to the 76th parallel.

During his drift in the *Fram*, Nansen discovered under a comparatively thin layer of cold Arctic water a powerful layer of water of Atlantic origin with positive temperatures. In 1935 the same water was encountered to the north-west of Severnaya Zemlya (Northern Land) by the Ushakov High Latitude Expedition in the *Sadko*. Lastly, the expedition in the *Krasin* in the same year, 1935, also discovered water with a positive temperature to the north of Herald Island. But all these instances relate to the borders of the polar basin, and it might have been presumed that the Atlantic water penetrating to the Arctic Ocean was pressed by the deflective action of the earth's rotation to the right, towards the Eurasian mainland. However, our investigations have shown that the Atlantic water flowing into the Arctic Ocean between Greenland and Spitsbergen in a powerful current reaches the Pole, apparently spreading extensively through the greater part of the polar basin.

At all the soundings, under the comparatively thin layer of cold Arctic water with negative temperatures common to polar seas, a layer was found with positive temperatures and of considerably greater density than the water of the surface layers.

At soundings taken to the north of the 86th parallel, the upper negative isotherm is at 250 metres, the lower at 750 metres. Thus the thickness of the layer of water with positive temperatures in the region near the Pole reaches 500 metres. The maximum temperature in this region is 0·77° C. (at a depth of 400 metres). Farther on, to the south, between the 86th and 85th parallels, the negative isotherms separate—the upper rising to a depth of 200 metres and the lower dropping somewhat deeper—to 750 metres. Thus the thickness of the layer of Atlantic water here increases. There is an increase also in the temperature of the water: plus 1° C. at a depth of 400 metres, and 0·88° at a depth of 250 metres. Farther to the south the layer of Atlantic water becomes more powerful, and the maximum temperature rose to 1·72° C. (at a depth of 250–300 metres).

At the 81st parallel we came out to the edge of the current of Atlantic water. The isotherms converged sharply as we drew nearer to the North East Foreland of Greenland.

The deep layers were filled with water of temperatures and salinity common to oceanic depths. In the layer at the bottom we observed somewhat higher temperatures—common to all deep oceanic hollows. At a depth of 4,390 metres the temperature of the water reached — 0·63° C. The cause of this rise in the temperature of the water of the bottom layer lies in the warmth flowing from the earth's crust, and also in the bacterial processes of decomposition of organic remains which have sunk to great depths. The heat generated during these processes may cause the rise in the temperature of the water.

With twenty-two hydrological soundings samples of plankton were taken at different depths. As we know, Nansen advanced the theory that the ocean was very poor in organic life in high latitudes. He believed the cause of this to be that under conditions of an ocean completely covered with fields of solid ice even in summer, plant plankton cannot develop owing to the absence of light, and as plant plankton, in the last resort, is the basic nourishment of the entire animal population of the sea, then naturally the higher animals, too, particularly sea animals, could not exist here. But this hypothesis has turned out to be incorrect. During the course of an entire month (August) our observations showed that under the solid ice, in the upper layers of the sea, an intensive development took place of microscopic sea-weed, constituting that 'florescence' of plankton, observable in the 'biological' spring in seas of more southern latitudes. This 'florescence' begins at the end of the short polar summer when all the snow has melted from the surface of the ice, which has also perceptibly suffered from the thaw. Evidently, at that time, the intensity of light penetrating to the water through the melting ice is sufficient for the development of seaweed.

The quantity of plant plankton was estimated by the quantity of chlorophyll, which was determined by a spectrocolorimeter. If plant plankton was able to develop here, then naturally it was possible for animal life to exist; and certainly from all depths of the ocean—even from a depth of 3,000 metres—the plankton net brought up examples of different species of animal plankton.

If plankton exists, it is also possible for the higher animals to exist, and at the 88th parallel we saw a hare, a polar bear with two cubs, not to mention seagulls, which visited our camp on more than one occasion. The hypothesis that no life exists near the Pole must therefore be assumed to be wrong.

Measurements of the force of gravity were made by us at twenty-two points, situated between the

89th and 74th parallels. At present, we have provisionally calculated thirteen of these gravitational points. The last points it was impossible to calculate, as the increasing rapidity of the drift towards the end compelled us to carry out all observations much more frequently and to postpone their working up. The difference between our results and the values given for the same points by the international formula is as follows. At the 89th parallel the observations of the force of gravity practically coincided with the theoretical values. From the 88th to the 84th parallel stretches a field of positive anomaly. Here our measurements give a value greater by approximately 60 mgm. than was supposed. From the 84th to the 83rd parallel is observed a sharp decline in the measured value. At the 83rd parallel the anomaly already has a negative significance of approximately — 30 mgm. Evidently this jump is closely connected with the relief of the bed. Here, as it happens, a rise to the shallow waters at the coasts of Greenland commences.

The object of our magnetic measurements was to elucidate the geographical distribution of the elements of terrestrial magnetism over the course of the drift : inclination, declination and horizontal intensity. For this we made our measurements with the help of a magnetic theodolite. During our stay on the ice floe, we made fifty-five series of determinations of inclinations and horizontal intensity, and thirty-six measurements of declinations. The measurements were taken right up to lat. 84° N. Farther on, the icefloe began to rotate so rapidly that it was impossible to use the variometers. It became necessary to take more frequent measurements in order, so far as possible, to weaken the effect of the magnetic disturbances. The measurements show that over the entire stretch of our drift there were no considerable magnetic anomalies.

With the setting in of the darkness at the beginning of October, we began to make hourly visual observations of the northern lights, and continued these until February 9.

Meteorological observations were carried out by us four times a day. We measured the temperature of the air, pressure (by two aneroids), humidity (in the summer by psychrometer; from August, during the periods of frosts, by a hair hygrometer of the Kuznetsov type), direction and velocity of the wind. At first all the four daily measurements of wind velocity were carried out by an anemometer. Later, when one of our anemometers went out of action, we used the remaining one only once a day, and the other three times determined the velocity of the wind visually. Up to the middle of October we have an unbroken record of wind velocity taken by the anemograph. The barograph and thermograph kept on functioning the whole time.

The rapid drift of the ice permitted us to spend only four summer months in the region of the cold polar cap, the investigation of which is of so great an interest to meteorology. It can now be said with certitude that the weather in this region is considerably calmer than on the borders of the Arctic Ocean. For example, we never observed any very strong winds there, though we did not find the steady anticyclonic regime supposed to exist in that region. Our observations were communicated to the mainland daily.

The foregoing is a provisional account of the results of our scientific work. Immediately on our return home we shall begin to work up our material, so as to give a complete account of the investigations carried out by our expedition to the North Pole.

Oil from Coal*

THE report of the Sub-committee on Oil from Coal of the Committee of Imperial Defence serves a useful purpose, although nothing new is disclosed. Unless unexpected discoveries of petroleum should result from the exploratory work conducted by oil companies as an outcome of the recent Petroleum Act, Great Britain has only one alternative to importing practically the whole of its oil supplies : that is, the large-scale conversion of coal into oil by hydrogenation or synthesis, processes which are still very costly in both capital and operation. Oil and motor spirit are produced in small proportions as by-products from the carbonization industries, but such sources are not capable of indefinite expansion, since their industrial stability is dependent upon adequate markets for the main products—coke of various kinds or gas. They were, however, stimulated by the guaranteed preference at the rate of 4*d*. a gallon for ten years which has operated in favour of home-produced motor spirit since the Act of 1934. Although only 4*d*. per gallon is guaranteed by this Act, the actual preference which has been in operation since 1934 has been 8*d*., but this involves a shortening of the period during which the guarantee is effective. The report recommends

* Committee of Imperial Defence. Sub-Committee on Oil from Coal : Report (Cmd. 5665). Pp. 71. (London : H.M. Stationery Office, 1938.) 1*s*. 3*d*. net.

that the *guarantee* should be increased to 8*d*. a gallon and remain in operation until 1950, and that it should be extended to include diesel oil used in motor vehicles.

It might be feared that this extension would involve a loss of revenue, but the consumption of oil and motor spirit is increasing so rapidly that any expansion of the various industries producing oil from coal would probably, at most, only provide for the increase, and could take place without reducing the present imports.

The Committee includes in its report a very welcome discussion of the position in time of war, and this probably forms its most valuable contribution. Much confusion has arisen in the past from the statements of parties interested in particular processes, or from well-meaning individuals who have based their deductions on incomplete knowledge. Even should carbonization processes expand to a degree wildly in excess of anything at present appearing commercially practicable, the supplies of motor spirit forthcoming would form only a small fraction of those needed in times of national emergency. The only methods which can be looked to as potential sources of large supplies of oil are hydrogenation and the Fischer or similar synthetic processes, where oil is the main product and is independent of the markets for coke and gas.

At present, only about 7 per cent of the motor spirit consumed in Great Britain is home-produced, and the home production of fuel oil, lubricating oil, etc., is negligible. An enormous expansion, involving the erection of many large plants, with consequent heavy capital expenditure, would thus be required to meet even peace-time demands. If such plants were put into operation, the consequent decrease in imported oil would eventually result in a considerable diminution of our sea transport facilities and make the possibility of import during war much more difficult. Moreover, large oil production plants would be extremely vulnerable to air attacks; and the man-power and supplies of coal needed for their operation, although an advantage in times of peace, might not be easy to provide when the fighting and munitions supply services were demanding all the men available. An interesting comparison is made between the capital cost of a plant with a yearly output of 150,000 tons of motor spirit (about £8,000,000) and the thirty-two tankers which could be built for the same sum, which, even if making only five voyages yearly, could carry 1,800,000 tons, or twelve times the output of the hydrogenation plant.

For these and other reasons, the Committee confirms the opinions already formed by those who have studied the subject impartially, that "in general a policy of depending on imported supplies with adequate storage is the most reliable and economical means of providing for an emergency".

Although in general agreement with the remarks of the Committee concerning low-temperature carbonization, the writer thinks it a pity that evidence in this field should have been taken only from the Low Temperature Distillers' Association of Great Britain, Ltd. In a subject which is still so experimental as low-temperature carbonization, an association of this character cannot be altogether representative, for, since it is not likely to welcome newcomers to introduce additional competition, much valuable data must be withheld from it. The Committee has, however, doubtless been in close touch with the Government Departments concerned in the matter.

C. H. LANDER.

Archæological Discovery in Britain, 1933-38

IN arranging an exhibition at the Institute of Archæology of the University of London to illustrate the achievement of field archæology in Great Britain and Northern Ireland during the five years 1933–38, the promoters have provided a conspectus of results which is continuous with those of the two exhibitions of a similar character held in 1929 and 1932, the latter in conjunction with the International Congress of Pre- and Proto-historic Sciences, which met in London in that year. The inevitable comparison demonstrates the very considerable advance made by archæological studies in the interval, and its direction.

The most striking feature in such a comparison is the increase in size of the present exhibition. This is not merely a matter of the total of exhibits, but also extends to the number of sites represented. For this the more efficient organization now possible is in part responsible; but unquestionably the decisive factors have been the growing activities of archæologists, and in no small degree an increased and more widely spread interest among a public which is prepared to support archæological excavation, financially and otherwise. For this part credit must be allowed to the Office of Works, which in the exercise of its statutory duties has

stimulated local authorities, local museums, local societies and a local public to preserve their ancient monuments, or where that has been impossible, to obtain from them such information relating to the past as they can be made to render up by skilled investigation before the evidence is obliterated. Among the more salient instances of such interest, of which the results are to be seen here, is the Old Jewry Wall site at Leicester, and the Belgic and Romano-British site at Colchester, whence comes the notable evidence of the factory of 'Colchester' ware, or local Samian.

Dr. R. E. Mortimer Wheeler, director of the Institute, in a short but illuminating introduction to the catalogue of the exhibition, regards it as demonstrating the extension of archæological field-work to provinces other than the Romano-British studies which, following the pre-War Haverfield tradition, dominated the early post-War years. This, no doubt, is true in some measure, but needs qualification. What is especially notable is not so much the change in the orientation of archæological studies as the increase in the number of professional or highly trained archæologists, whose interests and services are now available for investigation in the wider field, which previously was not so much neglected as for a variety of reasons left to the investigator who, though experienced and frequently of advanced technical skill, was not professionally trained. The effect of this change in the qualification of personnel is to be seen on all sides. Without risking invidious distinction, mention may be made of instructive examples in the mesolithic exhibits from Sussex, in which there is profound knowledge and trained experience behind the arrangement and classification of the finds from the pit-dwelling site at Selmeston, unique at present in British scientific investigation, and of the Tardenoisian industry from Horsham, for both of which Dr. J. G. D. Clark is responsible. The work undertaken by Mr. Alexander Keiller and the Morven Institute of Archæological Research at Avebury lends further support to the contention, as also does the material drawn from bronze and early iron age sites in Sussex, Gloucester and Wales.

It is a further mark of the trained habit of mind that help from other sciences is being sought in an increasing degree to give objectivity to the findings of the archæologist. The evidence of geology and palæontology on broad lines has always served the excavator; but to this are now added intensive investigations in geology, climatology, palæobotany, which call for the employment of laboratory methods. Prof. F. E. Zeuner, the distinguished authority on prehistoric chronology, who is now attached to the staff of the Institute, stages an exhibit of the methods of geochronology, in which he shows how mechanical and chemical analysis of soils and gravels can be made to show changes of climate and geological conditions, and demonstrates the tree-ring method of time measurement, which has been used extensively in American archæology. Two interesting and instructive examples of the use of analysis and experiment in field work appear among the exhibits from archæological sites. The first comes from Wales and establishes the earliest recorded use of coal as fuel in Britain in a bronze age cremated urn burial from the Simonston Cairn, near Bridgend, Glamorgan, excavated by Sir Cyril and Lady Fox. The second is included in material, also from Wales, excavated by Mr. B. N. St. J. O'Neil from Fridd Faldwyn Camp, Montgomery. It is an example of vitrification, which is compared with similar vitrified rock from a hill-fort in Bute, and also with vitrified material experimentally produced by Mr. Wallace Thorneycroft, who has thus solved a puzzle of long standing among Scottish archæologists.

Before leaving the subject of archæological technique, attention may be directed to the nucleus of a collection of photographs taken from the air for which Major G. W. G. Allen is responsible. Such photographs are now familiar as an instrument of survey and discovery; but the technique of ground photography is less widely appreciated. Enlarged photographs arranged by Mr. M. B. Cookson illustrate the varied points of technical detail recorded by skilled manipulation of the camera. Technical considerations apart, the photographs of interments of the defenders of Maiden Castle, Dorchester, are intensely impressive; while those of the recently reported investigation of the methods of construction of Hadrian's Wall are of special interest at the moment.

Finally, as an example of more or less straightforward excavation, carried out with a patience that is unlimited, which are the fundamentals of archæological method, reference may be made to Mr. A. Leslie Armstrong's excavation of the Pin Hole Cave, Creswell Crags, Derbyshire, in which twelve years' work has penetrated through twenty feet of deposits and has brought to light relics of three phases of Mousterian, separated by two glacial phases or events, of Solutrean and of Aurignacian, the last including an engraving of a man masked for a ceremonial dance unique in Britain.

It may seem that in directing attention to the more salient features of the exhibition, which mark progress and direction in British archæology, too little has been said of individual exhibits. This is not due to any lack of interest. While there is no section which does not repay study, those

which cover the early iron age and more particularly the period immediately before the Roman invasion, open up a field which a few years ago was unmapped. All sections alike in quality and number of exhibits testify not only to the skill of the investigators, but also to the value of this branch of scientific research in Britain as a source of material for the advancement of knowledge of man's cultural development and history.

Dr. Wheeler points out that recent development in archæological studies implies an elaboration of technique rather than a change of heart, while the position of General Pitt-Rivers as the founder of scientific archæology remains unchallenged. So long as this obtains, there is the less need for Dr. Wheeler's admonition to the archæologist to bear in mind that he is not merely a mechanic, but is also a student of humanity. If there be any danger, Dr. Wheeler's own excavations of Verulamium and Maiden Castle, which hold an outstanding position in the exhibition, spur his colleagues to emulation and guide them along the right path.

Obituary Notice

Sir Harcourt Butler, G.C.S.I., G.C.I.E.

BY the death of Sir Harcourt Butler, termed one of the greatest administrators in India of his day, which took place on March 2 at the age of sixty-eight years, oriental studies in the University of London have lost one of their strongest supporters.

Spencer Harcourt Butler was the second son of Mr. Spencer Percival Butler, conveyancing counsel to the Office of Works, a nephew of Dr. H. M. Butler, Master of Trinity College, Cambridge, and a brother of Sir Montagu Butler, now Master of Pembroke College, Cambridge. Born on August 1, 1869, Harcourt Butler was educated at Harrow and Balliol College, Oxford. He passed into the Indian Civil Service in 1888 and went to the United Provinces of Agra and Oudh, where he remained and served with conspicuous success until 1907, when he was chosen by Lord Minto to act as secretary of the Foreign Department, an office which brought him into close personal touch with the native princes. In 1910, Butler was appointed to the newly created post of education member in charge of sanitation, local self-government, archæology and other minor branches of public works. Butler took up the administration of these heterogeneous activities with vigour.

In 1915, Sir Harcourt (as he had become three years before) was transferred to Rangoon as Lieutenant-Governor of Burma. One of his early achievements was to raise a substantial sum for the provision of a teaching university in Rangoon to take the place of the colleges previously affiliated to Calcutta. In 1917 he returned to his old Province to take office as lieutenant-governor; but in 1923 he returned to Burma to become Governor under the new system inaugurated in 1919.

Butler's activities during this second term of office in Burma have met with criticism in two directions. He had already shown enthusiasm for education both in Rangoon and previously in India, where he had encouraged the foundation of universities at Benares for Hindus and at Aligarh for Moslems; while in his time in Oudh the University of Lucknow had been created and the University of Allahabad had been reconstructed. On his return to Rangoon, he found that his scheme for a university was languishing. He brought forward fresh legislation, and schemes were framed for raising money. Both measures met with much opposition and even aroused some personal animosity.

In another direction, Butler's actions have been regarded as not in the best interests of those he intended to serve. This was the abolition of slavery and human sacrifice in the land of the savage Nagas known as the Triangle, the then unadministered territory bordering on the Hukwang Valley. Butler was successful in stamping out these practises; but while they are repugnant to civilized ideas and not permissible under British administration, the anthropologist has to recognize that the abolition of slavery, at least without adequate substitute, economically has had a damaging effect in forcing land out of cultivation and reacting adversely on the morale of the tribes.

On leaving Rangoon in 1927, Butler was appointed chairman of the Indian States Committee to report on the relationship between the Paramount Power and the States. The report issued in 1929 proved a standard of reference on the question of federation in the Round Table Conference which followed.

On his return to England, among numerous other activities Butler accepted in 1931 the chairmanship of the Governing Body of the School of Oriental Studies, and took a prominent part in the arrangements for the new quarters of the School in Bloomsbury, now approaching completion. Among the numerous honours bestowed upon Sir Harcourt Butler were honorary doctorates from the University of Oxford and several of the Indian universities.

WE regret to announce the following deaths:

Mr. E. A. S. Fawcett, C.B., chief engineer to the Ministry of Health from 1921 until 1930, on April 1, aged sixty-nine years.

Mr. Edward Meyrick, F.R.S., assistant master at Marlborough College from 1887 until 1914, an authority on Australian Lepidoptera, on April 1.

Mr. T. H. Digges La Touche, formerly of the Geological Survey of India, on March 30, aged eighty-two years.

News and Views

An Extra-galactic Star Cluster

IT is reported by the New York correspondent of *The Times* that Dr. Harlow Shapley has announced the discovery of a great cluster of stars in the southern constellation Sculptor. The discovery was accidental, the cluster being photographed with the 60-inch reflector at the Harvard Southern Station at Mazelspoort, near Bloemfontein, South Africa, on a very clear night with a highly sensitive plate. If the median absolute magnitude of the stars photographed be assumed to be $-1{\cdot}5$, the apparent magnitude being about $+18$, it follows that the distance of the cluster is about 250,000 light-years. This places it well beyond the limits of our galactic system, the distance being more than double that of the Magellanic Clouds, and adds another to the known systems that are relatively near to our galactic system. The angular diameter of the cluster is greater than 1° and the linear diameter is estimated to be about 6,500 light-years, which indicates a size comparable with the Small Magellanic Cloud. The cluster is oval-shaped, unlike the clusters in our galactic system, which are globular. It is stated that there are about 10,000 stars in the cluster between the brightest stars and the dimmest that have yet been counted. The Magellanic Clouds are rich in stars of very high luminosity. The Sculptor cluster would undoubtedly have been discovered earlier, if it had contained such stars. It is probable that, when further photographs are available, Cepheid variables will be discovered in it and the study of their light variations will enable a more accurate determination of the distance of the cluster to be made.

Bequests for Research in Marine Biology

MR. EDWARD THOMAS BROWNE, a governor of the Marine Biological Association, who died on December 10, 1937, was for many years the leading authority in Great Britain on medusæ and other cœlenterates. Under his will, a number of valuable bequests are made to different bodies for the benefit of scientific research. The residue of his estate, estimated to amount to some £50,000, goes to the Royal Society to form a fund for the promotion of marine expeditions or individual research on marine biology. In addition, £6,725, together with scientific books, instruments and apparatus, are left to the Marine Biological Association for special purposes in connexion with the Plymouth Laboratory, £15,000 to Queen's College, Oxford, for a research fellowship and a scholarship in biology, and £5,000 to University College, London, for a postgraduate research studentship in zoology, in memory of his wife. After graduating at Oxford, Mr. Browne took up the serious study of zoology under the late Prof. W. F. R. Weldon at University College, London, in 1891, and remained at the College as a research worker until 1909. His summers were spent at different marine laboratories, Port Erin, Plymouth, Millport and at other places suitable for his work, including Valencia, Falmouth and the Scilly Isles. A monograph on the British medusæ is nearly completed, and provision is made in his will for its publication. He examined and reported on the medusæ from many foreign collections, especially from expeditions, including those from the Maldive and Laccadive Archipelago, the Gulf of Manaar, the Indian Ocean, the Suez Canal, the Scottish Antarctic Expedition, the British National Antarctic Expedition, the Falkland Islands, Norway and Spitsbergen. Browne was a very thorough and careful worker, with a complete knowledge of the literature of the groups in which he specialized. He gave great assistance both financially and, as a member of their respective councils, in the administration of the scientific societies in which he was interested, including the Royal Microscopical Society and the Quekett Club.

Soviet Awards for North Polar Expedition

ON p. 629 of this issue we print an account of the preliminary scientific results obtained by the Russian men of science who occupied the drifting north polar station. The Riga correspondent of *The Times* states that the following awards have been made to members of the expedition: M. Ivan Papanin, already a 'Hero of the Soviet Union' and a member of the Order of Lenin, has received the second class of that order and a present of 30,000 roubles, and has been appointed first deputy chief of arctic navigation (of which Prof. Otto Schmidt is chief). MM. Krenkel, Shirshoff and Fedoroff have been decorated with the Order of Lenin, awarded the title of 'Hero of the Soviet Union', and also received 30,000 roubles each. The captains of the *Taimyr*, *Murman* and *Murmanets*, and M. Ostaltseff, who conducted the relief expedition on board the *Taimyr*, and the airman, M. Vlasoff, have been decorated with the Order of Lenin and received 10,000 roubles each; and 118 others who took part in organizing the expedition to the North Pole and the rescue of the ice-floe party have been awarded various other decorations and sums of money.

Bronze Age Cairns in Glamorganshire

Two cairns of the bronze age, adjoining the village of Coity, near Bridgend, Glamorganshire, excavated by Sir Cyril Fox, director of the National Museum of Wales, and Lady Fox have made notable additions to the records of British archæology. The Simondston Cairn affords evidence of the earliest known use of coal as fuel in the British Isles. In the second, the Pond Cairn, was found a pit containing the remains of vegetation and grains of wheat and barley, believed to be the first food grains of the bronze age

recorded in southern Britain. The excavations were described before the Society of Antiquaries of London by Sir Cyril Fox on March 31. The Simondston Cairn is of the normal highland Early Bronze Age type and contains burials of two adults and a child, dating from about 1600 B.C. In the southern rim of the cairn were five cremation burials of about a generation later. It was in one of these that the traces of coal were identified. The nearest outcrop of coal is about a mile and a half away. The second cairn, Pond Cairn, lies half a mile away from Simondston and is on a lower level. It is of a very unusual type both as regards its structure and the ritual acts involved in the construction. Near the centre was a rock-cut pit, probably dedicatory, which was filled with stones and contained the scattered burnt bones of a child. The primary burial was an urn of about 1300 B.C. which was covered with a heap of stones and a vertical-sided turf stack. A basin with a projection, phallic in plan, and lined with charcoal, fronted the urn. Around the turf stack was a continuous cairn ring, sixty feet in diameter, with an inner wall face and outer kerb. The space between the ring and the stack was scattered over with charcoal, and had been trodden hard, presumably in some ceremonial movement. Later the inner face of the ring was broken and the pit, to which reference is made above, was dug. It was covered with a pile of stones, linking the ring with the stack. The Pond Cairn is comparable with examples in Devon. With the secondary deposits at Simondston it probably represents an intrusion across the Severn Sea into the Glamorgan plain.

Roman Dorchester

RESUMED excavation on behalf of the Dorset Archæological Society on the site at Colliton Park, Dorchester, which has been purchased by the County Council for the erection of a shire hall, has already produced several discoveries (*The Times*, March 3). It will be remembered that last year, when excavation began, a large Roman town house was discovered belonging to the Roman city of Durnovaria which underlies the modern town. This has been completely excavated and is to be preserved intact by the County Council. Trial trenches have now revealed that four important Roman buildings underlie the area upon which the shire hall is to be erected. These it is hoped to examine. A well-made path of cobble flints leading to the door of the house has been brought to light. It overlies an earlier wooden cookhouse, furnished with an oven. A large pit was also found. This was circular in plan and lined with blocks of stone. It is fourteen feet in diameter and sixteen feet deep. A passage to the west leads to the Roman town wall. Excavations will be continued for a further period of at least three months.

Jungfraujoch Research Party

AT the end of this month Mr. G. Seligman, author of "Snow Structure and Ski Fields", will take a party of scientific workers to the Jungfraujoch Research Institute in Switzerland to undertake scientific research work on glaciers. This will be the first British expedition ever to spend its whole time studying glaciological problems, and it will form a continuation of Mr. Seligman's previous researches on the nature of snow. The party will spend five months at the Institute, at a height of more than 11,000 feet, and will consist of: Mr. T. P. Hughes, of the Physical-Chemical Laboratory, Cambridge—physicist; Mr. M. F. Perutz, of the Crystallographic Laboratory, Cambridge—crystallographer; Mr. A. E. Benfield, of the Department of Geodesy and Geophysics, Cambridge, and Mr. E. A. Ferguson, of the Department of Geography, Cambridge—assistants. The chief problem to be investigated will be the transition of firn into glacier ice, but other problems, particularly those which may have some bearing on the main question, will be investigated, notably the movement of glaciers, the formation of ice-bands and the connexion, if any, between those in the névé regions and those near the snout of the glacier. In addition, Mr. Hughes will carry out certain experiments on the friction of solid bodies on ice, in connexion with his work at the Physical-Chemical Laboratory, Cambridge. Mr. Seligman has been granted a Leverhulme Research Fellowship for the purpose of this research, and the expedition is also supported by the Royal Geographical Society, the Ski Club of Great Britain and the Alpine Ski Club.

Changing Conceptions of Education

AT a public meeting of the Derbyshire County Association of the National Union of Teachers on March 26, Mr. A. E. Henshall, education secretary of the Union, spoke on present-day teachers' aims and attitudes as contrasted with those of their predecessors. The attitudes established by the notorious payment-by-results system persisted long after its abolition, but to-day there is fairly general acceptance of the view that the teacher is concerned before everything else with the welfare of the individual child, considered as a person destined in due course to contribute to the welfare of the community as a citizen of a democratic State. It follows, at least in theory, that teachers of children in all stages in every kind of school—infants, junior, senior, central, secondary—are united in a single task and owe it to themselves and their charges that they should co-operate as fellow workers in a unitary service. To promote such co-operation by providing convenient occasions for getting together and comparing notes is an important function of the local associations of the National Union. Mr. Henshall stressed the pioneer role of the new senior schools and warned their teachers against sacrificing their comparative freedom in a misguided effort to rival the secondary schools. With equal emphasis he insisted on the importance of the junior schools, the teachers of which should be regarded as having a status not inferior to that of senior school teachers.

Social Services of the League of Nations

IN an article entitled "The Non-Political Value of the League" contributed to the *Quarterly Review* for

January, Capt. A. L. Kennedy gives an admirable survey of the services rendered by the League of Nations technical organizations in non-political fields. He stresses the value of the resettlement of populations in Greece under the League Commission as a contribution to European peace and indicates the need for dealing with questions of refugees and minorities which still persists. In regard to opium, the co-operation established at Geneva has resulted in a central office which maintains supervision over a complete branch of economic activity, from the import of the raw material to the consumption of the manufactured article and in checking its transport from one country to another. This achievement has, however, set the League the even harder task of suppressing the illegitimate traffic which still flourishes to a serious extent and also the task of controlling the raw material. Again, the League has provided a central body for collating and directing measures against the traffic in women and children, and it has every claim to be regarded as the world's ministry of health, not only co-ordinating health work in different countries, as well as research and standardization but also, as in the Singapore Epidemiological Intelligence Bureau, providing an intelligence service for the prevention of epidemics. Capt. Kennedy writes appreciatively of services rendered to China before the onslaught of Japan occurred as well as to the reconstruction work in Austria, the work of the Mandates Commission and of the International Labour Office and the Permanent Court of International Justice. This well-balanced assembly of facts leaves no room for doubt that if the failure to use the League in the political sphere led to its abandonment, we should require an exactly similar organization to carry on its present non-political activities if both nations and individuals are not to be deprived of services which have given and are giving them relief from want and suffering, higher moral and material standards and opportunities of a useful life.

Scientific Research in New Zealand

THE eleventh annual report of the Department of Scientific and Industrial Research, New Zealand, covers the year 1936–37, and, in addition to the secretary's report and the reports of the research committees of the Council, includes the reports of the Dominion Laboratory, the Geological Survey Branch, the Meteorological Branch and the Dominion, Apia and Magnetic Observatories. The Minister's covering statement refers to the establishment of a Bureau of Social Science Research, the work of which will include the co-ordination of the activities of research bodies or individuals in this field and the undertaking of investigations to assist the Government by providing the factual bases for social policy measures. Outstanding developments of the year were the reorganization of plant research under the Plant Research Bureau and the steps taken to establish an Animal Research Bureau. The Plant Diseases Division of the former Bureau has made good progress in the study of virus diseases of farm crops, particularly tobacco, and has also completed comparative trials of new organic mercury dusts. Diseases of tomatoes and potatoes, etc., have also been investigated, and the Entomological Division of the Bureau has obtained satisfactory results in the biological control of the white butterfly, although new lines of attack for the control of the diamond black moth have been necessary. The Dairy Research Institute has made further progress in its study of the control of gas-producing organisms which cause openness in cheese, and has continued its studies of the elimination of the feed taint in butter and cream from certain districts.

THE Wheat Research Institute has continued to expand its long-range work on wheat breeding, while the Leather Research Laboratory has given special attention to methods of assessing the quality of leather as a guide to improvements. A particular group of chemical constituents has been studied in relation to the wearing-value of leather. An extensive programme of fruit research has included an attack on the problem of the mouldy core of apples and the control of internal cork of apples, while the soil and land utilization survey has been continued to give a fairly complete picture of the agricultural resources of the Hawke's Bay province. Other features of the year have been the establishment of the Standards Institute, which has already done much to promote the adoption of standards and establish committees and sub-committees covering a wide range of subjects. Evidence is already available of the benefits of this work to the Dominion. Research associations have been developed during the year in connexion with the tobacco, wool manufacturing and footwear manufacturing industries, and a feature of staff appointments during the year has been the recruitment of New Zealand science graduates who had migrated overseas. Of the total expenditure of £131,957 of the Department, £71,233 is on research investigations, £13,268 of which is derived from industries and £13,243 from sales and miscellaneous recoveries. Expenditure on the Dominion Laboratory was £17,261 and on the Meteorological Office £12,069.

The Ontario Research Foundation

THE report of the Ontario Research Foundation for 1936 refers to the increased work carried out for industry. Two new laboratories for research on paints and on air-conditioning are now running smoothly. In the former, investigations on weathering tests and chemical analysis of white house paints, weathering of structural metal paints, etc., are in progress, while the latter is investigating the 'summer' comfort requirements in regard to temperature and humidity of people in Toronto. The work of the Textiles Division has been concerned with the development of a textile oil for use in processing woollen materials as well as with the development of a process for high-resistance tusser silk for electrical insulation purposes, and with processes for the reduction of shrinkage in textile materials. The Division of Engineering and Metallurgy has continued its studies

on the effect of heat treatment on chilled cast-iron and on the forgeability of metals. The Division of Biochemistry has been concerned with the development of a new system of combination vegetable tannage for sole and transmission belting leather. A microscopic method for the early diagnosis of bovine mastitis has been worked out by the Division of Pathology and Bacteriology, while other work of the Foundation has been concerned with the deodorization and partial hydrogenation of cod liver oil without destroying the vitamin content, with the incidence of diseases of apples and related problems, and with a process for transferring pigments used in the paint industry from aqueous pastes to the oil phase.

Desiccation in Africa

A SUPPLEMENT to the *Journal of the Royal African Society* of January entitled "The Man-made Desert in Africa: Erosion and Drought" by Prof. E. P. Stebbing offers yet another warning that in many parts of the world drifting sand and eroding soil are beginning seriously to clog the wheels of administrative machinery. Erosion is a matter in which African Governments interfere unwillingly, for effective control often means uprooting social, agricultural and religious customs upon which tribal life, which British Governments strive to preserve, is based. In this paper, Stebbing regards erosion primarily from the point of view of its effect on water supplies, and believes that with increasing erosion, a falling water-table and decreasing water supplies, the character of the rainfall deteriorates, wet years becoming less, and droughts more frequent, and of longer duration. When deterioration has reached what Stebbing terms the "intermittent rainfall stage", where continuous agriculture is scarcely feasible, man has his last chance to change his methods and prevent the final encroachment of the desert. Much of Africa seems to have entered upon this critical stage of deterioration, and some parts have passed it irrevocably. Stebbing emphasizes that now "it is for the Administration to act". The immediate needs for Africa's conservation are more money and more officers trained to the work. Given these, administrations might put into operation soil conservation programmes which, if carried out, would turn the scales, at or before the intermittent rainfall stage, against the desert's encroachment. The trouble is that we cannot tell, until we have tried them out, whether plans for soil conservation are compatible with plans for the harmonious social development of whites and blacks.

Grass Seed Production

THREE new bulletins have been issued in the Herbage Publication Series by the Imperial Bureau of Plant Genetics, Aberystwyth. Bulletin 19, "Production of Grass Seed" (price 5*s*.), is edited by R. O. Whyte and consists of an international exchange of opinions and experiences on the technique of producing seed of graminaceous herbage and forage plants. The countries represented are Scotland, Northern Ireland, New Zealand, the United States, Germany and Sweden, the names and addresses of the contributors being supplied in each case. Bulletin 20, "Insect and other Pests injurious to the Production of Seed in Herbage and Forage Crops" (price 2*s*. 6*d*.), has been prepared by H. F. Barnes. This paper is essentially a summary of the available information concerning some of these pests, but although growers should find this most useful, they are nevertheless advised to consult the advisory entomologist in their particular area as to the best method for safeguarding their crops, as it is impossible to secure really satisfactory results without due attention to local conditions. Bulletin 21, "The Influence of Climatic Conditions on Type Composition", by Nils Sylvén (price 1*s*.), gives an account of experiments in Sweden on the changes induced in herbage plants grown for seed outside their proper growing districts. It is evident that there is considerable danger of loss of valuable characters if this process is continued. For satisfactory results, seed must be obtained direct from the breeding station or its vicinity, and care taken to keep seed from the original source scrupulously apart from that grown in a different locality, or much of the value of the selection work will be lost.

Education in the Indian Villages

A PAPER by Capt. J. W. Petavel before the Economics Society of Osmania University on September 24 last year emphasizes the value of educative employment in the economic system of the Indian village, and particularly that of the educational colony in Indian rural education. One of the greatest possibilities to be explored, however, is that of the use of educational colonies for town children and adolescents, and these should be for the benefit of poor middle-class people as well as for the working classes and should include secondary as well as primary education. Stress is laid in this system on productive work, and the scheme of factory colonies outlined is also advocated as a contribution to improved world relations. Both in the rural and in the factory colonies one of the primary needs is the co-operation of scientific men and other professional workers in leadership and on a part-time basis in teaching and other capacities. Moreover, the colony organization offers one of the best opportunities of dealing with India's root problem of increasing the productivity of the land to yield more food for her growing population. The establishment of a standing committee for unemployment and poverty problems, to plan and assist research in the directions indicated by the success of the Swiss labour colony of Witzwil, is also urged.

Report of the University of Leeds

THE University of Leeds report for 1936–37 records as the outstanding event of the year a gift of £200,000 by Mr. Frank Parkinson. It is significant that the report gives prominence to Mr. Parkinson's expressed belief "that the university can render the highest service to the community by keeping the realities of life and the need of breadth of vision in

human affairs before its students" and refers to an expression of the same belief by Lord Nuffield. Among other endowments were an anonymous gift of £20,000 and a legacy of £25,000 for founding a chair of psychology. The subject of employment of graduates is dealt with at greater length than is usual in these annual reports. In the technological departments, no difficulty was found in obtaining employment immediately after, and even before, graduation. To meet the situation created by the time-lag between graduation and employment in the teaching profession the Appointments Board exerted itself to find temporary summer employments. The usefulness of this Board is said to have greatly increased during the last few years, the number of vacant appointments notified to it having risen from 380 in 1932 to 3,500 in 1937. Appreciative reference is made to the report on employment of graduates published by the National Union of Students. Schemes for medical examination of students at their own option and for physical instruction were under consideration during the year and are now in process of realization.

Quantitative Economics

IN a paper on econometric researches, appearing in the series of publications dealing with economic problems edited by Dr. R. Gilrat (No. 412; Hermann and Cie., 6 Rue de la Sorbonne, 6, Paris, 1936), Prof. R. Ray deals with the demand for goods for direct consumption. Results obtained in this question of demand, whether by experimental methods or by the application of statistical methods to observations, afford a strong presumption in favour of the quantitative investigation of economic phenomena. Prof. Ray discusses the theories of Cournot, Dupint and Marshall, who considered demands as the function of a single variable, as well as the theories of Walras and the mathematical school. His own investigations on products for direct consumption suggest that for certain products or services, coefficients of elasticity can be used to characterize the demand. In considering the elasticity of demand, it is essential to analyse the part which the law of substitution plays, and accordingly it is desirable to limit the investigations to products which lend themselves less readily than others to substitution, or to investigate a group of products which are readily substituted one for another in meeting the same need. The method of multiple correlation offers interesting possibilities, and Prof. Ray concludes that the demand for goods or services investigated so far is nearly always inelastic.

Effects of Dry Rot in Ships

THE presidential address of Dr. John Ramsbottom to the Essex Field Club dealt with dry rot in ships. Its text appears in the *Essex Naturalist* (25, 231; 1937), and provides an interesting account of the struggle of naval builders with wood-rotting fungi. A historical survey from the sixteenth century onwards traces the use of various kinds and qualities of timber, and shows how prone they were to rotting within the vessel, and above the water-line. The diarist Pepys made some contributions towards an understanding of the problem, but it was largely the work of James Sowerby, the author of "English Fungi", which first directed attention to the real cause. He figured twenty-three species of "Fungi found in the Dockyards and Ships of Great Britain from Deptford to Plymouth 1812". *Merulius lachrymans* was included in the list, and there can be little doubt that it was one of the chief agents of decay. Many substances were used to impregnate timber in an effort to control the rot; but it was not until the appearance of ironclad ships that dry rot ceased to trouble the Royal Navy.

The Rabbit Problem

IN certain localities, as is well known, the prevalence of rabbits has become of some importance in horticulture, agriculture and forestry. In order to deal with this nuisance effectively and humanely, the University of London Animal Welfare Society (ULAWS) has published a pamphlet, entitled "Instructions for Dealing with Rabbits", compiled by Capt. C. W. Hume, in which the chief methods of rabbit destruction are fully described. In addition, a list of some relatively rabbit-proof plants and details of rabbit-proof fencing are given. Sir Frederick Hobday, in a foreword, commends the pamphlet, a copy of which will be sent free on receipt of a stamped envelope measuring 6 in. by 9 in. by ULAWS, 42 Torrington Square, London, W.C.1.

Cambridge Dissertations for Degrees

A BOOK of "Abstracts of Dissertations approved for the Ph.D., M.Sc. and M.Litt. Degrees in the University of Cambridge" during the academic year 1936–37 has been issued (Published by Authority: The University Press, Cambridge, 1937.) Each summary has been approved by the examiners or by the student's supervisor, and gives a good idea of the matter of a dissertation. Copies of the dissertations are deposited in the University Library (Ph.D. degrees) or in the University Registry (M.Sc. and M.Litt. degrees).

Reference Standards Laboratory

AFTER a delay of many years, the establishment of a laboratory for the maintenance in Australia of standards of length, mass, electrical units, etc., has been approved by the Commonwealth Government. It will probably be placed at Canberra, the estimated cost of the building being £80,000. The administration will be in the hands of the Council for Scientific and Industrial Research, which will maintain intimate contact with the National Physical Laboratory at Teddington in general accordance with a plan drawn up some ten years ago.

National Academy of the Lincei

A SUPPLEMENTARY number of the *Atti della Reale Accademia Nazionale dei Lincei* (1937) contains an account of the formal annual meeting held in Rome on June 6, 1937, in the presence of H.M. the King of Italy, to whom tribute was also paid for the first

time as Emperor of Abyssinia. Among the chief awards announced by the President, V. Rossi, are those of the Bocconi Prize for cancer research to Prof. F. Pentimalli and the Cannizzaro Prize in chemistry to Prof. L. Ruzicka, Zurich. The following were elected as members during the preceding year: A. Ghigi, D. de Blasi, P. G. Goidanich, L. Castiglioni, P. Ducati, A. Maiuri, P. de Francisci, F. Flora, as national members, and A. Carrelli, G. Polvani, F. Ercole, as corresponding members. The centenary of the death of the Italian poet, Giacomo Leopardi, was commemorated by an address given by G. Gentile.

Royal Academy of Belgium: Prize Awards

THE following prize awards have been announced by the Royal Academy of Belgium: the Théophile Cluge Prize to Dr. J. J. Bouckaert for his work on physiology; the Agathon De Potter Prize for astronomy to S. Arend, for mathematics to F. Bureau, for physics to J. Géhéniau, for chemistry to Prof. W. Mund, for mineralogy to E. Polinard, for biology to Z. M. Bacq and to L. Lison; the Schepkens Prize to J. Beirnaert for his work on genetics and the improvement of the oil palm; the Wetrems Prize to L. Coppens for his work on fire-damp.

Announcements

DR. L. J. SPENCER, formerly keeper of minerals in the British Museum (Natural History), has been elected a corresponding member of the American Museum of Natural History, New York.

AT the general meeting at Indianapolis of the American Society of Plant Physiologists, Prof. Henry H. Dixon, of Trinity College, Dublin, was elected an honorary corresponding member of the Society.

Sir Walter Langdon-Brown and Prof. W. J. Dilling have been nominated by the Privy Council members of the council of the Pharmaceutical Society of Great Britain, in succession to Sir Humphry Rolleston and Prof. J. A. Gunn, who have retired. Sir Malcolm Delevingne will continue as the third member nominated by the Privy Council.

A COMMITTEE has been appointed under the chairmanship of Mr. John Forster with two representatives of the Medical Research Council, Sir David Munro and Mr. Bradford Hill, two representatives of the London Passenger Transport Board, and two representatives of the Transport and General Workers Union to investigate the conditions of work and their effect on health of the London omnibus workers.

AT the annual general meeting of the Ray Society on March 24 the following officers were re-elected: *President*, Sir Sidney F. Harmer; *Treasurer*, Prof. F. E. Weiss; *Secretary*, Dr. W. T. Calman. Prof. F. Balfour-Browne was elected a vice-president, and Dr. J. Ramsbottom and Mr. J. L. Chaworth-Musters new members of the council. It was announced that a translation by the late Sir Arthur Hort of the "Critica Botanica" of Linnæus will shortly be published and that among other works in preparation is one on the distribution and ecology of British spiders by Dr. W. S. Bristowe.

DR. HEINRICH VON FISCHER, professor of meteorology at Vienna, has been made an honorary member of the German Meteorological Society and has been awarded the Silver Hillmann Medal by the Air Minister of the Reich.

THE twenty-fourth Annual Conference of the National Association for the Prevention of Tuberculosis will be held at the British Medical Association House, Tavistock Square, W.C.1, on June 30–July 2.

THE Royal Sanitary Institute will hold a further course of instruction in disinfestation of houses and furniture from the bed-bug, beginning on May 16. Further information can be obtained from the Secretary, 90 Buckingham Palace Road, S.W.1.

THE All-India Population and Family Hygiene Conference will be held at Bombay on April 16–19 instead of in January as originally announced. Further information can be obtained from the Honorary Secretary, 8 Ormiston Road, Apollo Bunder, Bombay.

THE third International Congress for Microbiology will be held at the Waldorf-Astoria Hotel, New York City, on September 2–9, 1939, under the auspices of the International Association of Microbiologists and the presidency of Dr. T. M. Rivers, Rockefeller Institute for Medical Research, New York. Further information can be obtained from the General Secretary, Dr. M. H. Dawson, College of Physicians and Surgeons, 620 West 168th Street, New York, or from Dr. R. St. John-Brooks, Lister Institute, Chelsea Bridge Road, London, S.W.1.

THE International Federation for Documentation will hold its fourteenth International Conference on Documentation under the presidency of Sir William Bragg at Lady Margaret Hall, Oxford, on September 21–25. Members of the Conference will visit the Science Museum, London, on September 26. Advantage will be taken of the meeting being in England to hold joint sessions on the mornings of September 24–25 with the Association of Special Libraries and Information Bureaux. Further information can be obtained from the Secretary, Miss M. Gosset, The Science Library, South Kensington, London, S.W.7.

GUSTAV FOCK, Leipzig, has issued an important catalogue listing close on 4,000 items, of which, in addition to journals and works of general zoology, the most extensive series deal with the physiology and biology of animals, psychology, zoogeography, and animals of economic importance. From Antiquariaat Junk, Den Haag (Holland), comes a list of 2,014 items concerning the one group Vermes.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 650.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Resonance Transmutations of Carbon by Protons

DURING the investigation of the capture radiation of light elements bombarded by protons, we have found for carbon the following results. The intensity of capture radiation was measured for different proton energies by the number of coincidences produced in a pair of Geiger-Müller counters. The coincidences were caused by electrons released from an aluminium plate by the incident γ-radiation. The quantum energy of this radiation was determined by finding the range of the electrons in millimetres of aluminium absorber placed between the counters. The intensity of γ-ray emission at different bombarding voltages is shown by Curve 1 of Fig. 1. Two resonances are clearly observed at 400 and 500 kv. approximately. With a bombarding proton energy of 560 kv., corresponding to the second peak of this curve, we find the γ-ray energy to be 7·4 Mv., as deduced from the end-point at 11 mm. of aluminium (Curve 1, Fig. 2). This is in marked disagreement with the value of the γ-ray energy to be expected from the reaction

$$^{13}C + {}^{1}H = {}^{13}N + h\nu \quad . \quad . \quad . \quad . \quad (1)$$

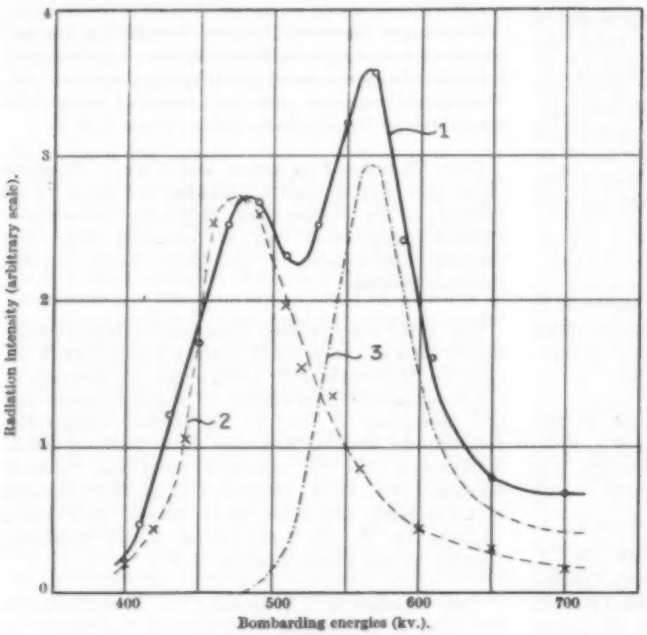


Fig. 1.

RESONANCE CURVES FOR ^{12}C AND ^{13}C.

However, if we consider the reaction

$$^{13}C + {}^{1}H = {}^{14}N + h\nu, \quad . \quad . \quad . \quad . \quad (2)$$

it is found by calculation, using accepted mass values and taking into account the energy of the incident protons, that the γ-ray energy is 8·2 Mv. for this process. This reaction has not previously been observed, and the following experiments confirm that the resonance peak of Fig. 1 at 560 kv. must be ascribed to the rarer isotope ^{13}C and not to ^{12}C.

The quantum energy of the capture γ-radiation was again measured with the energy of the incident protons changed from 560 kv. to 470 kv. Curve 2 of Fig. 2 shows the new absorption measurements in aluminium, and the γ-ray energy deduced is 2·6 Mv. For comparison the absorption measurements obtained under the same conditions with the γ-rays of thorium C″ are shown by the crosses of Fig. 2. Using the accepted mass values in equation (1), we find that for protons of energy 470 kv. the γ-ray emitted should have an energy of 2·37 Mv., in good agreement with our experimental value of 2·6 Mv. The above results suggest that the peak in the γ-ray excitation curve at 470 kv. must be attributed to the formation of the radioactive ^{13}N, whilst the peak at 560 kv. must be attributed to the formation of stable ^{14}N.

It is strange to notice that Hafstad and Tuve[1], in a measurement of the amount of radioactivity excited at different proton energies, obtained some evidence for two resonances at 400 kv. and 480 kv. The association, however, of the two resonances found by these workers with the resonances which we find in the capture γ-excitation is not possible on account of the above measurements of the energies of the γ-rays and our proposed interpretation. In view of this coincidence, however, we have repeated Hafstad and Tuve's measurements of the excitation of radioactivity at different proton energies. Our results, shown in Curve 2 of Fig. 1, give no evidence of the second resonance found by Hafstad and Tuve. This curve for ^{13}C was obtained by bombarding the same target with protons for a fixed interval of time and measuring the subsequent positron emission with a thin-walled Geiger-Müller counter. It has been reduced to make the best fit to Curve 1 for the capture γ-radiation. We note that only the first peak at 470 kv. in the γ-ray excitation curve can be

associated with the radioactivity. The ^{13}C resonance curve can be found by subtracting Curve 2 from Curve 1 and is shown as Curve 3 of Fig. 1, with a threshold value for resonance at about 500 kv. It

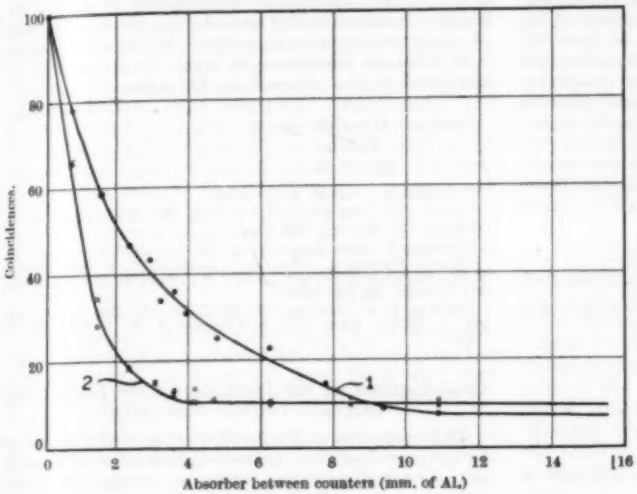


Fig. 2.

CURVE 1. ^{13}C CAPTURE RADIATION; CURVE 2. ^{13}C CAPTURE RADIATION (CIRCLES); THORIUM C'' RADIATION (CROSSES).

is interesting to note that ^{13}C has such a large cross-section for proton capture that its yield is of the same order as that of ^{12}C, though it is about 1 per cent abundant in natural carbon.

P. I. DEE.
S. C. CURRAN.
V. PETŘÍLKA.

Cavendish Laboratory,
Cambridge.
March 14.

[1] Hafstad and Tuve, *Phys. Rev.*, **48**, 306 (1935).

The λ-Phenomenon of Liquid Helium and the Bose-Einstein Degeneracy

IN a recent paper[1] Fröhlich has tried to interpret the λ-phenomenon of liquid helium as an order–disorder transition between n holes and n helium atoms in a body-centred cubic lattice of $2n$ places. He remarks that a body-centred cubic lattice may be considered as consisting of two shifted diamond lattices, and he assumes that below the λ-point the helium atoms prefer the places of one of the two diamond lattices. The transition is treated on the lines of the Bragg-Williams-Bethe theory as a phase transition of second order in close analogy to the transition observed with β-brass. Jones and Allen in a recent communication to NATURE[2] also referred to this idea. In both these papers, use is made of the fact, established by the present author, that with the absorbed abnormally great molecular volume of liquid helium (caused by the zero motion[3]) the diamond-configuration has the lowest potential energy among all regular lattice structures[4].

In this note, I should like first to show that the mechanism proposed by Fröhlich cannot be maintained and then to direct attention to an entirely different interpretation of this strange phenomenon.

(1) According to Fröhlich, a diamond lattice of He atoms, when partly formed, should offer, to any other He atom, a preference for being attached at those points which belong to the same diamond lattice, that is, the binding energy at a diamond point should be greater than anywhere else. It is, however, easy to see that just those points, which according to Fröhlich should become less favoured for low temperatures, have an appreciably greater binding energy. It is true these holes have four nearest neighbours at exactly the same distance (3·08 A.), as the lattice points of the diamond lattice have, but in addition they possess six second neighbours at the distance of 3·57 A. which the diamond lattice points do not possess, and these second neighbours contribute considerably to the binding energy just at the hole-places (about 50 per cent to the potential energy). Therefore, actually no such co-operative phenomenon will appear as supposed by Fröhlich. The atoms would rather frequent the holes as much as the proper diamond lattice points, and this would signify that we have a body-centred lattice of $2n$ places for n atoms, every place being occupied with the probability $\frac{1}{2}$ only—even at the absolute zero. In this configuration every atom has on the average four nearest neighbours at a distance of 3·08 A., as in the diamond configuration, but in addition there are here on the average three second neighbours at the distance of 3·57 A. In the diamond lattice there are twelve second neighbours but at a distance of 5·04 A., where there is almost no Van der Waals field. It might be mentioned, by the way, that a face-centred lattice of $2n$ places for n atoms (on the average 6 first neighbours at a distance of 3·17 A.) has been found to have a still little lower energy than the configuration just discussed of the co-ordination number 4.

Complete numerical details cannot be given here; in any event it can be shown by such energetic discussions that a static spatial model of liquid He II of whatever regular configuration is certainly not possible. This has been previously suggested in consideration of the great zero point amplitude calculated for He[4]. The determination of the most favourable co-ordination numbers of the first and second neighbours, however, maintains a good physical meaning: it may be considered as a rough Hartree calculus which yields the self-consistent field and the corresponding probability distribution of the atoms belonging to the minimum of energy.

(2) It seems, therefore, reasonable to imagine a model in which each He atom moves in a self-consistent periodic field formed by the other atoms. The different states of the atoms may be described by eigen functions of a similar type to the electronic eigen functions which appear in Bloch's theory of metals; and, as in Bloch's theory, the energy of the lowest states will roughly be represented by a quadratic function of the wave number K,

$$E = \frac{h^2}{2m^*} K^2,$$

the effective mass m^* being of the order of magnitude of the mass of the atoms. But in the present case we are obliged to apply Bose-Einstein statistics instead of Fermi statistics.

(3) In his well-known papers, Einstein has already discussed a peculiar condensation phenomenon of the 'Bose-Einstein' gas; but in the course of time the degeneracy of the Bose-Einstein gas has rather got the reputation of having only a purely imaginary existence. Thus it is perhaps not generally known that this condensation phenomenon actually represents a discontinuity of the derivative of the specific heat (phase transition of third order). In the accompanying figure the specific heat (C_v) of an *ideal* Bose-Einstein gas is represented as a function of T/T_0 where

$$T_0 = \frac{h^2}{2\pi m^* k}\left(\frac{n}{2{,}615}\right)^{2/3}.$$

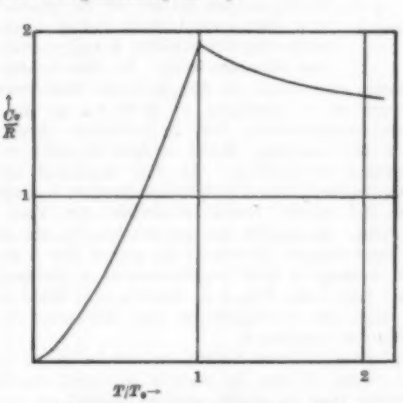
With m^* = the mass of a He atom and with the mol. volume $\frac{N_l}{n} = 27{\cdot}6$ cm.^{3} one obtains $T_0 = 3{\cdot}09°$. For $T \leqslant T_0$ the specific heat is given by

$$C_v = 1{\cdot}92\ R\ (T/T_0)^{3/2}$$

and for $T \geqslant T_0$ by

$$C_v = \frac{3}{2}\ R\left[1 + 0{\cdot}231\left(\frac{T_0}{T}\right)^{2/3} + 0{\cdot}046\left(\frac{T_0}{T}\right)^{2} + \ldots\right]$$

The entropy at the transition point T_0 amounts to $1{\cdot}28\ R$ independently of T_0.



SPECIFIC HEAT OF AN IDEAL BOSE-EINSTEIN GAS.

(4) Though actually the λ-point of helium resembles rather a phase transition of second order, it seems difficult not to imagine a connexion with the condensation phenomenon of the Bose-Einstein statistics. The experimental values of the temperature of the λ-point (2·19°) and of its entropy ($\sim 0{\cdot}8\ R$) seem to be in favour of this conception. On the other hand, it is obvious that a model which is so far away from reality that it simplifies liquid helium to an ideal gas, cannot, for high temperatures, yield but the value $C_v = 3/2\ R$, and also for low temperatures the ideal Bose-Einstein gas must, of course, give too great a specific heat, since it does not account for the gradual 'freezing in' of the Debye frequencies.

According to our conception the quantum states of liquid helium would have to correspond, so to speak, to both the states of the electrons and to the Debye vibrational states of the lattice in the theory of metals. It would, of course, be necessary to incorporate this feature into the theory before it can be expected to furnish quantitative insight into the properties of liquid helium.

The conception here proposed might also throw a light on the peculiar transport phenomena observed with He II (enormous conductivity of heat[5], extremely small viscosity[6] and also the strange fountain phenomenon recently discovered by Allen and Jones[3]).

A detailed discussion of these questions will be published in the *Journal de Physique*.

F. LONDON.

Institut Henri Poincaré,
Paris.
March 5.

[1] Fröhlich, H., *Physics*, **4**, 639 (1937).
[2] Allen, J. F., and Jones, H., NATURE, **141**, 243 (1938).
[3] Simon, F., NATURE, **133**, 529 (1934).
[4] London, F., *Proc. Roy. Soc.*, **A**, **153**, 576 (1936).
[5] Rollin, *Physics*, **2**, 557 (1935); Keesom, W. H., and Keesom, H. P., *Physica*, **3**, 359 (1936); Allen, J. F., Peierls, R., and Zaki Uddin, M., NATURE, **140**, 62 (1937).
[6] Burton, E. F., NATURE, **135**, 265 (1935); Kapitza, P., NATURE, **141**, 74 (1938); Allen, J. F. and Misener, A. D., NATURE, **141**, 75 (1938).

Cross-Sections of the Deuteron for the Electric and Magnetic Nuclear Photo-effect

THE cross-section for the scattering of slow neutrons by protons leads to the assumption of a ^1S level in the deuteron nucleus, with an energy of about 100,000 volts[1]. Fermi[2] showed that the capture of thermal neutrons by protons can be understood qualitatively as a magnetic dipole transition from a ^1S level to the fundamental ^3S level of the deuteron. The amount of the capture cross-section would still depend on the sign of the ^1S level. For a virtual ^1S level, the mean life of neutrons in water (not paraffin) should be $\tau = 2{\cdot}9 \times 10^{-24}$ sec. For a real level $\tau = 6{\cdot}3 \times 10^{-4}$ sec. The values for a virtual level are in good agreement with the recently obtained experimental value[3], $\tau = 2{\cdot}7 \times 10^{-4}$. The evidence obtained by the scattering of thermal neutrons by ortho- and para-hydrogen indicates as well a virtual level[4].

The photo-disintegration of the deuteron by γ-rays may take place by two transitions: the magnetic photo-effect is the inverse of the capture, a ^3S–^1S transition, it leads to uniform angular distribution of the neutrons and protons. The photo-electric effect is due to a ^3S–^3P transition, and consequently the number of protons or neutrons emitted per unit solid angle should be proportional to the sine^2 of the angle between the incident γ-ray and the photo-particles. The relative contribution of the two photo-effects depends on the sign of the ^1S level. For 2·6 Mev. γ-rays the ratio of the number of neutrons or protons observed in the direction of the incident γ-ray to the number observed at 90° is expected to be

$$I_0/I_{90} = 0{\cdot}29 \text{ for a virtual level}^5.$$
$$= 0{\cdot}13 \text{ for a real level.}$$

Chadwick, Feather and Bretscher[6] observed the angular distribution of 65 photo-protons obtained by the γ-rays of thorium-C′ in a cloud chamber. The total angular distribution seems to show a contribution of the magnetic effect, which is still lower than the one expected for a real level.

I have measured the number of photo-neutrons emitted by a sphere of heavy water (diameter = 10 mm.) in the direction of the γ-rays and at 90° to this direction. As a source 450 mc. of mesothorium were used, the neutrons were detected by the artificial

radioactivity of 3 gm. of dysprosium oxide, placed at 33 cm. distance from the heavy water in a paraffin cone of 10° opening. The number of kicks observed at 90° ± 20° to the γ-rays was 700 ± 42, and only 47 ± 40 were observed in the corresponding time at 0° ± 20°. For a pure $\sin^2$ distribution one should expect for the given geometrical conditions at 0°, 5 per cent of the intensity observed at 90°. This result confirms the observation of Chadwick, Feather and Bretscher; the magnetic photo-effect will scarcely yield more than 5 per cent of the photo-electrical intensity observed at 90°, instead of 29 per cent expected. The cross-section of the deuteron for the total photo-effect for 2·64 Mev. γ-rays was obtained by counting the total number of neutrons slowed down in a large tank filled with water, after the method developed by Amaldi and Fermi[7] and Amaldi, Hafstad and Tuve[8]. The total cross-section is found to be $9 \pm 0{\cdot}8 \times 10^{-28}$ cm.^{2}. The cross-section for the electric effect is therefore 9×10^{-28} cm.^{2}, in good agreement with theoretical expectation. An upper limit of 6×10^{-29} cm.^{2} can be indicated for the magnetic effect; this value is much lower than that derived from the capture cross-section of protons for thermal neutrons.

I thank Prof. Urbain for the generous gift of 3 gm. dysprosium oxide and "La société de produits chimiques des terres rares", who kindly lent me the mesothorium source.

HANS V. HALBAN, JUN.

Laboratoire de Chimie Nucléaire,
Collège de France,
Paris.
Feb. 19.

[1] Wigner, *Phys. Rev.*, **51**, 106 (1937).
[2] Fermi, E., *Ric. Sc.*, **7**, 2 (1936).
[3] Frisch, Halban, Koch, NATURE, **170**, 895 (1937).
[4] Dunning, Manley, Hoge, and Brickwedde, *Phys. Rev.*, **52**, 1076 (1937); Halpern, Esterman, Simson and Stern, *Phys. Rev.*, **52**, 142 (1937); Schwinger and Teller, *Phys. Rev.*, **52**, 286 (1937).
[5] See Bethe and Bacher, *Rev. Modern Physics*, **8** (1936). For the number given here the scattering cross-section was assumed to be 18×10^{-24} cm.^{2} for 'free protons' and slow neutrons, and the difference of the magnetic moments of proton and neutron 4·2 nuclear magnetons.
[6] Chadwick, Feather and Bretscher, *Proc. Roy. Soc.*, A, **154**, 366 (1937); see also Richardson, R., and Emo, L., *Phys. Rev.*, **53**, 234 (1938).
[7] Amaldi, Fermi, *Phys. Rev.*, **50**, 899 (1936).
[8] Amaldi, Hafstad and Tuve, *Phys. Rev.*, **51**, 896 (1937).

Wilson Chamber Study of the Neutro-Electric Effect

IN our previous letter describing the results of our Wilson chamber study of the neutro-electric effect[1], we stated that we had found the paired tracks of a proton and an electron in such numbers as would be expected from our counter experiments (assuming the validity of the conservation laws for the energy and momentum).

Since then, we have taken photographs of 10,538 proton tracks; of these 6,448 were taken by using D—D neutrons, and the remaining 4,090 were taken with Li—D neutrons. In each case we found three paired tracks. This is about one sixth of what is expected. Though it is not impossible that they are due to accidental coincidence of the two independent tracks, the fact that we could find no paired track in which the electron starts from the end of the proton track seems to indicate that they are true pairs.

The smaller effect compared with our former result might be explained partly by the fact that the photographs were much clearer in the present case than in the former, and the accuracy of discriminating whether or not the tracks were true pairs was raised considerably, and partly to the statistical fluctuation. No definite conclusion can be drawn from our present result. One may only say that the neutro-electric effect cannot be explained in terms of the direct interaction of the neutron with the atom satisfying the conservation laws, if our previous cross-section determination is not in error by a factor of about 6.

SEISHI KIKUCHI.
HIROO AOKI.

Department of Physics,
Osaka Imperial University,
Osaka.
Feb. 26.

[1] NATURE, **141**, 328 (1938).

High-Pressure Afterglow in Nitrogen

A MOST remarkable afterglow in nitrogen has been observed at pressures higher than 10 mm. This afterglow has certain properties which would scarcely be looked for in an afterglow at high pressures. The most striking of these is the relatively strong excitation of the Vegard-Kaplan intercombination bands, which originate on the $A^3\Sigma$-metastable state of nitrogen. Their intensity relative to the usually strong second-positive bands is as high as the intensity in the night-sky afterglow which I reported several years ago[1]. The remarkable nature of this phenomenon will be realized when it is pointed out that the weak night-sky glow was produced at pressures of approximately 0·01 mm. by means of a very feeble exciting discharge, while this strong new glow is produced at about 1,000 times that pressure by means of a very strong exciting discharge. In fact, the relative intensity of these bands has been increasing steadily with pressure in the range so far studied. This is an anomalous result in view of the metastability of the $A^3\Sigma$ level. Moreover, the high-pressure afterglow is more intense and has a longer life than similar glows at lower pressures.

There is present on these afterglow plates a strong line at a wave-length of approximately 3470 A., which has not yet been identified. Its behaviour, as the tube cleans up and the nitrogen becomes purer, is now being studied. It is important, too, that a relatively strong unidentified line or band has been reported by both Dufay[2] and Gauzit[3] in the light of the night sky at a wave-length of 3471 A. The presence of this line in the new high-pressure afterglow, in companionship with the Vegard-Kaplan bands, which are strong in the light of the night sky, suggests that it may be the hitherto unobserved atomic nitrogen line $^2P - {}^4S$, the predicted position of which is also 3470 A. If this be true, then the auroral transition $^2P - {}^2D$ should be much stronger in the afterglow, as well as in the light of the night sky, than 3470 A. The approximate position of the components of the $^2P - {}^2D$ transition is at 1·0373 μ, and until it is observed in the present experiments or in the light of the night sky, the above proposed identification of the 3470 line as the trans-auroral transition $^2P - {}^4S$ should be considered tentative. It may be pointed out, however, that the infra-red lines at 1·0373 μ would be the nitrogen analogue of the well-known auroral green line.

Added weight is given to the identification of the 3470 line as the unknown atomic nitrogen line, rather than as the second-positive band at 3469, by the fact that the second-positive bands, which are usually stronger than 3469, are either absent or

weaker in the light of the night sky. A discovery of this significance for the physics of the upper atmosphere must be carefully considered, and a programme of exhaustive investigation of the 3470 line is now under way. Until further study, therefore, the identification must be given as a tentative one, attractive as the above arguments may sound.

JOSEPH KAPLAN.

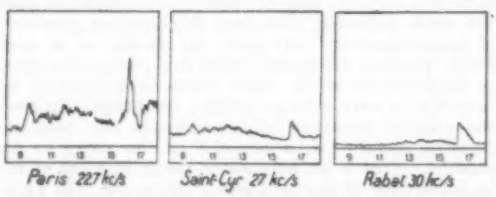
Departments of Astronomy and Physics,
University of California,
Los Angeles.

[1] Kaplan, *Phys. Rev.*, **48**, 800 (1935).
[2] Dufay, *J. Phys.*, vii, **5**, 523 (1934).
[3] Gaunit, *J. Phys.*, vii, **5**, 527 (1934).

Effect of Catastrophic Ionospheric Disturbances on Low-Frequency Radio Waves

K. G. Budden and J. A. Ratcliffe[1] have described an effect of catastrophic ionospheric disturbances on low-frequency radio waves (16 kc./s.), but this action did not show an increase in atmospherics.

This last statement agrees with our observations. It is certain that an increase in atmospherics seldom appears on a frequency of 12 kc./s. This has been known for several years. A recent observation shows that, on a frequency of 17 kc./s., increase had already disappeared.



Increases noticed at Paris (22 kc./s.), St. Cyr (27 kc./s.) and Rabat (30 kc./s.) on November 6, 1936 (date of the anomally published by K. G. Budden and J. A. Ratcliffe), are shown on the accompanying figure.

R. BUREAU.

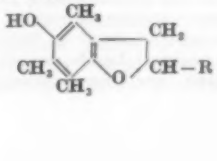
Office National Météorologique,
196 rue de l'Université,
Paris, VII^e.
Feb. 19.

[1] NATURE, **140**, 1060–1061 (1937).

Vitamin E: Structure of β-Tocopherol

IN a recent publication[1] we indicated that β-tocopherol, $C_{28}H_{48}O_2$, might be a coumaran or chroman derivative bearing a long side chain in the heterocyclic nucleus.

With the view of testing this hypothesis, we have synthesized 5-hydroxy-2 : 4 : 6 : 7-tetramethylcoumaran (I), m.p. 124–125°, starting from pseudocumoquinol and allyl bromide, and also 5-hydroxy-4 : 6 : 7-trimethyl-2-*n*-heptadecylcoumaran (II), m.p. 95–95·5°, isomeric with β-tocopherol, from pseudocumoquinone and ethylsodiostearoylacetate followed by partial hydrogenation of the intermediate coumarone.



I R = CH_3
II R = $C_{17}H_{35}$

Both the synthetic coumarans are very similar to β-tocopherol in absorption spectrum and reducing properties.

Substance	Wave-length		ε mol.	
	Max.	Min.	Max.	Min.
β-tocopherol	295mμ	260mμ	3577	529
'Heptadecylcoumaran' ..	297mμ	258mμ	3993	624
'Methylcoumaran' ..	296mμ	270mμ	3840	1305

When thermal decomposition is attempted, synthetic 5-hydroxy-4 : 6 : 7-trimethyl-2-*n*-heptadecylcoumaran distils at 370° without charring, giving a mixture from which a trace of a quinol is obtained, m.p. 185–190° (subl.) (cf. thermal decomposition of tocopherols, *loc. cit.*).

These results together with the surface film measurements of Dr. Danielli, recorded below, give support to the view that β-tocopherol is a coumaran derivative. The detailed configuration of the side chain, and the distribution of CH_3-groups in the ring system remain to be determined. Side methyl estimations of β-tocopherol indicate the presence of six or seven $CH_3(C)$. Two or possibly three of these can be attached to the aromatic nucleus; the remaining three to five can be accounted for by formulating the side chain and the heterocyclic nucleus as a 'dihydrophytyl'-like structure; such a structure would explain also the oily nature of the vitamin and the ready production of quinols on thermal decomposition. This hypothesis is supported by results of oxidation: two oily fatty acids, C_{17-14} and C_{11-13}, are obtained, giving crystalline phenylphenacylesters.

F. BERGEL.
A. JACOB.
A. R. TODD.
T. S. WORK.

Biochemical Department,
Lister Institute,
London.
March 10.

[1] Bergel, Todd and Work, *J. Chem. Soc.*, 253 (1938).

Both β-tocopherol allophanate and 5-hydroxy-4 : 6 : 7-trimethyl-2-*n*-heptadecylcoumarone spread on *N*/100 hydrochloric acid to give stable films. The limiting area of the first compound is 30 sq. A. and that of the coumarone is 26 sq. A. *p*-Hexadecylcyclohexanol has a limiting area of 30 sq. A. and the lactone of γ-hydroxystearic acid an area of 29 sq. A. It may therefore be concluded that the first two compounds mentioned are analogous in structure and that in cross-section β-tocopherol cannot have a ring system more than one ring in thickness measured perpendicular to the side chain. The ring system cannot be analogous to a phenanthrene or sterol skeleton.

J. F. DANIELLI.

Department of Biochemistry,
University College,
London.
March 10.

Function of Carbon Dioxide in the Metabolism of Heterotrophic Cells

In recent years the indispensability of small quantities of carbon dioxide for the growth of very diverse heterotrophic cells has been amply demonstrated. For a fairly recent survey of literature, reference may be made to the paper of Gladstone, Fildes and Richardson[1]. Until now, however, no explanation has been given for this unexpected phenomenon.

Two possibilities present themselves. In the first place, the fact that very common types of bacteria, yeasts and fungi proliferate in a given medium if traces of carbon dioxide are present, but do not do so in its absence, may mean that carbon dioxide is the starting point for the synthesis of some essential cell constituent. This implies, of course, that carbon dioxide will be chemically converted, or in other words reduced, by the heterotrophic cells of the inoculum. Although it seems improbable that this power is a universal property of the numerous heterotrophic organisms for which the indispensability of carbon dioxide has already been demonstrated, the possibility cannot be at once rejected in view of the results obtained in the recent studies of Woods[2], Wood and Werkman[3], Barker[4] and others.

It may, however, suffice to state here that all attempts made so far to obtain experimental evidence in favour of this assumption have been unsuccessful.

A second possible explanation for the necessity of carbon dioxide for the growth of heterotrophic cells might be sought in a demonstration that this compound is essential for the functioning of the energy-yielding reactions normally occurring in the cells of the inoculum. Since only aerobic organisms have been studied, this would mean that the ultimate removal of carbon dioxide from the cells interferes with the respiration process. This would imply that carbon dioxide is not only essential for the proliferation of heterotrophic cells, but also for the respiration of a suspension of preformed 'resting cells'.

After experiments to test this hypothesis had already been started, I found that a similar suggestion had been made by Krebs[5], who, however, did not offer experimental support for his assumption that carbon dioxide might act as a hydrogen carrier in the respiration of *B. coli*.

I have now succeeded in proving that carbon dioxide is, indeed, essential in the normal functioning of the oxidation-reduction catalysts in various heterotrophic cells, in so far at least that complete removal of carbon dioxide leads to an inhibition of methylene blue reduction. It was found that this reduction under the usual conditions is fully prevented if the medium is rigorously freed from the last traces of carbon dioxide previous to the test. For this purpose, some solid caustic potash was placed in the side bulb of a Thunberg-Keilin tube, and the tubes were shaken, keeping them at a temperature of 0° C. to prevent reduction before the removal of the carbon dioxide was completed. After some hours the tubes were incubated in a water bath at 37° C. in order to test whether or not reduction of the dye would occur. Using *B. coli* or *B. prodigiosum* as test organisms, no reduction took place although the experiment was continued for 24 hours; control tubes submitted to a similar pre-treatment, with calcium chloride instead of caustic potash in the side bulb, readily reduced the methylene blue.

With organisms like *Saccharomyces ellipsoideus* (Chambertin yeast), *Aspergillus niger* or *Prototheca* species which ordinarily contain large quantities of reserve carbohydrates—easily leading to carbon dioxide production in the cells—no absolute inhibition of methylene blue reduction could be obtained, but the time necessary for the reduction was considerably prolonged, showing that here the same condition prevails.

I am much indebted to Prof. A. J. Kluyver at Delft (Holland) for his kind help in guiding me with many suggestions during the investigation.

J. W. HES.

Service des Fermentations,
Institut Pasteur,
Paris.
March 14.

[1] *Brit. J. Exp. Path.*, **16**, 335 (1935).
[2] *Biochem. J.*, **30**, 515 (1936).
[3] *Biochem. J.*, **30**, 48 (1936).
[4] *Archiv f. Mikrobiol.*, **7**, 404 (1936).
[5] *Biochem. J.*, **31**, 2095 (1937).

Dissolving Action of Micro-Organisms on Milk-Wool

MILK-WOOL is now becoming of universal interest, and samples are being shown now and then of textile products containing 50 or even 100 per cent of this material. It appears to us, however, that due consideration should be given to the question, whether these products can withstand the biological agencies provided by Nature in the form of organisms able to assimilate and mineralize protein substances of the class to which casein belongs.

ABOVE: MILK-WOOL PLATE. DISSOLVING ACTION OF MICRO-ORGANISMS.
BELOW: PIECE OF 100 PER CENT MILK-WOOL TEXTILE. LEFT: TWO HOLES, CAUSED BY STERILE PIECES OF CLARIFIED MILK-WOOL AGAR. RIGHT: PIECE OF SAME AGAR, NON-INOCULATED, AS CONTROL (NO CHANGE).

These considerations have induced us to investigate the possibility of isolating casein-splitting organisms, which are also capable of attacking the formol-hardened casein, milk-wool.

It was found that nearly all casein-splitting micro-organisms, isolated from soil or manure, or gathered by infection from the ordinary atmosphere, are able to attack the wool. They belong to all classes: bacteria, moulds, actinomyces, many of which show a very strong dissolving action when grown on water-agar plates containing the usual

inorganic salts and finely divided milk-wool threads. These organisms invariably act by an exo-enzyme, and so a fairly large zone is developed around the places of their growth, where every thread of milk-wool is dissolved and the milky white agar has become completely transparent. Pieces of agar from this zone, when applied to a piece of textile material of 50 per cent milk-wool, were able to destroy all the milk-wool beneath them, leaving the 50 per cent of genuine wool unattacked. The 100 per cent milk-wool textile was completely dissolved, resulting in a hole after two days, as the accompanying illustration shows. The enzyme was inactivated by boiling.

The direct action of the micro-organisms, when applied to pieces of textile material, lying on agar-plates, which contained only inorganic salts, was equally deleterious.

The experiments are being continued in several directions.

JAN SMIT.
B. VAN DER HEIDE.

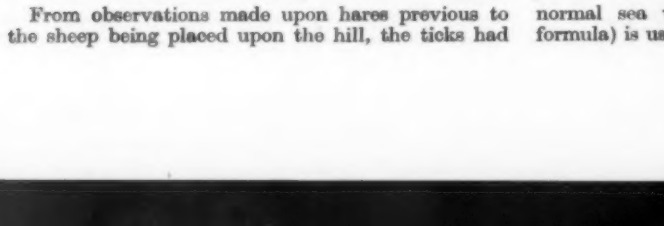
Microbiological Laboratory,
Agricultural Highschool,
Wageningen.
March 3.

Activity of the Sheep Tick

THE activity of the sheep or grass tick, *Ixodes ricinus* L., in Great Britain has been reported by various workers[1,2,3] to be confined to two periods of the year: (*a*) spring activity, extending from March until early June, (*b*) autumn activity, from late August until the end of September. Outside these periods, ticks are said to be scarce during the summer months and completely inactive in winter.

In the spring of 1937, an investigation was commenced by us upon the incidence of *Ixodes ricinus* in the Deeside area, and it has been found that its activity differs very widely from that reported in other parts of the country.

The accompanying graph, showing the seasonal activity upon one hill-grazing, is representative of data obtained from several holdings. In making the tick counts upon the sheep, only the adult females upon the head and neck and on the bare skin beneath the forelegs were counted. This method, which is also in use by other observers, enables one worker to examine large numbers of sheep and allows some comparison to be made with the results obtained by other workers.



SEASONAL ACTIVITY OF TICKS IN NORTH-EAST SCOTLAND

From observations made upon hares previous to the sheep being placed upon the hill, the ticks had already begun their activity in this district during the first week in April. The sheep were attacked as soon as they grazed upon the hill and the infestation progressively increased to a peak in the month of July, after which there was a gradual decrease. When the sheep were removed from the hill on November 25 there was still an average infestation of 0·5 ticks per sheep.

During the month of December the worst snow-storm for many years swept the country, and we assumed the ticks would become inactive for the remainder of the winter.

On January 12, 1938, two stags were shot which had ticks attached, one a fully engorged female, which, from its appearance, had become attached about ten days previously, when the hills were still covered with snow. This female commenced egg-laying on February 5.

On January 27, a flock of sheep upon a tick-infested pasture on another hill were found to have an average of 1·5 adult female ticks attached to the head and neck and the bare skin beneath the legs, in addition to large numbers of males, nymphs and larvæ. Five deer, which were shot on this date, were found to be carrying a total of 42 adult female and 25 male ticks. The flock of sheep was again examined on February 9 and had an average of 1·2 female ticks attached.

From these observations it appears that tick activity is continuous throughout the year in north-east Scotland, the seasonal incidence being greatest during the summer and lowest in winter.

Further work upon this problem, aided by a grant from the Agricultural Research Council, is proceeding, and detailed results will be published elsewhere.

JAMES HENDRICK.
WALTER MOORE.
GUY D. MORISON.

Marischal College,
Aberdeen.
March 1.

[1] Wheler, E. H., *Proc. Roy. Agric. Soc., Eng.*, **4**, 626 (1899).
[2] Stewart, W. L., *Proc. Roy. Agric. Soc., Eng.*, **97**, 81 (1936); MacLeod, J., *Parasitology*, **24**, 396 (1932).
[3] MacLeod, J., *Parasitology*, **27**, 298 (1936).

Tube Formation in *Pomatoceros triqueter* (L.)

AMONG the scientific effects of the late Frank A. Potts was found the following account of tube formation in the serpulid worm *Pomatoceros triqueter*, a subject on which he had been working intermittently for some time.

The apparently homogeneous keeled tube is seen in longitudinal section to be composed of successive rings of calcium carbonate. The substance of the tube is of a mucoid nature in which small crystals of aragonite are deposited. Each successive ring is formed by the peristomial collar which arises from the ventral wall. As the animal lies on its back, the ventral surface with the collar is uppermost.

When the animal is removed from its tube it will live for an indefinite period, and in normal sea water will form one or two calcareous rings. If instead of normal sea water artificial sea water (Dittmar's formula) is used, the worms live almost as well as in

normal sea water and produce rings with equal facility. If the animals are taken out of their tubes and placed in artificial calcium-free sea water, they will live for a number of days and are apparently normal, but they do not produce calcareous rings. Animals which have been kept like this in calcium-free sea water, if transferred back to normal sea water, produce calcareous rings. If animals removed from their tubes are placed in artificial sea water in which there is half the amount of calcium chloride required by Dittmar's formula, that is, about 210 mgm. instead of 420 mgm. calcium per litre, they will form rings at roughly the same rate of deposition as when the normal amount of calcium chloride is present. From preliminary experiments, it appears that the amount of calcium can be further reduced without inhibiting the production of calcium carbonate.

The above experiments show an independence of food in the calcium carbonate forming activities. If worms which have been feeding are at once removed to calcium-free sea water, they are unable to form the calcareous rings. There are no organs in *Pomatoceros* which might act as special stores of calcium. If the blood be considered as a possible store of calcium, it may be mentioned that the frequent severe hæmorrhage which occurs on removing the worm from its tube does not interfere with the immediate production of calcareous rings. The evidence so far collected points to the sea water as the source of the calcium required for tube building.

In Nature the production of the calcareous tube begins in March and goes on until August or September. The length of life of *Pomatoceros* is from two to three years at least. The animal begins its tube building activities in the spring presumably about the time it begins to feed, and it builds its tube continuously until the autumn.

J. D. ROBERTSON.
C. F. A. PANTIN.

Department of Zoology,
University of Cambridge.
Feb. 28.

Relation between Structure of Pine Leaves and their Position on the Tree

THE quantitative anatomical method has recently acquired an increasing importance in determining the face, the form, or even the variety of various cultivated plants. It has also been applied in the study of the leaf of the pine (*Pinus silvestris* L.)[1,2,3]. Unfortunately, however, scarcely any of the investigators have considered the position on the tree to which are attached the leaves taken for study. Whereas, so early as 1904, Zalensky[4] discovered the law which has, in the Russian literature, acquired the name of 'Zalensky's law' (Maximov[5]), but which, unfortunately, remained unknown in western Europe and was considerably later rediscovered by a number of investigators[6]. Zalensky, studying monocotyledonous and dicotyledonous plants on a very extensive and variegated material, showed that the higher up on the tree the leaf grows (or the nearer to the end of the branch) the greater the xeromorphic properties it acquires; that is, the epidermis and mesophyll cells are smaller, the conducting strand is thicker, the cuticle and wax coating are thicker, the stomata are greater in number and smaller, the palisade tissue is more clearly defined. It was to be expected that a similar law would be found for Gymnospermæ, except that, in connexion with the peculiar structure of the leaf in conifers, it would take a slightly different form.

An investigation of the leaves of several pines by stages confirmed this supposition. It was shown that the higher up on the tree (or closer to the end of the branch) the leaf grows, the longer, broader, and thicker it is; the central cylinder is wider and thicker, the conducting bundles are larger, the resin canals are greater in number and larger, the epidermis is thicker. The difference between the upper and lower stages of hundred-year-old pines in the length and breadth of the leaves, in the thickness of the conducting tissue, in the number of resin canals, reaches 25 per cent[7].

Thus, in every quantitative anatomical study of the leaves of *Pinus*, it is necessary to choose material for comparison from the same regions on the tree, which have grown under similar conditions. Failure to observe this rule may completely destroy the value of the results of the investigation.

M. MOISSEJEWA.

University,
Kiev.

[1] Grahle, A., *Jahrb. Wiss. Bot.*, **89** (1933).
[2] Sokoloff, P. J., *Bull. Jard. Bot. Princ. U.R.S.S.*, **27** (1928).
[3] Schaternikowa, A., *Tr. po lesn. opytn. delu*, **56**, 2 (1929).
[4] Zalensky, W. J., "Quantitative Anatomy of the Different Leaves from the Same Plant" (Kiev, 1904). Dissert. Russ.
[5] Maximov, N. A., "The Physiological Basis of Drought-Resistance of Plants" (Leningrad, 1926).
[6] Yapp, R. H., *Ann. Bot.*, **23** (1912).
[7] Moissejewa, M., *J. Inst. Bot. Acad. Sci. U.S.S.R.* (1938). (Symposium dedicated to the memory of Academician Fomin.)

Blood Groups of the Noluas of Bengal

THE Noluas are a group of people who collect reeds and manufacture different types of basket from it. They live in four districts of Bengal—Jessore, Khulna, Faridpur and Nadia. Their total strength is 1,704-884 males and 820 females. They are a short-statured, mesocephalic and mesorrhine people.

I examined the blood of 100 adult male Noluas of four districts, 25 from each. All the samples were examined carefully with fresh standard serum. The following are the data which I obtained: group *O*, 16 per cent; group *A*, 38 per cent; group *B*, 33 per cent; group *AB*, 13 per cent.

M. N. BASU.

Department of Anthropology,
University of Calcutta.
Feb. 16.

"Clay"

IN NATURE of April 2, Dr. A. B. Searle refers at some length to a discourse on clay which I gave at the Royal Institution a few months ago. Dr. Searle is too generous to me in his account of our present knowledge of clay structure. The application of the X-ray methods to this difficult but most interesting problem was, in the first place, based on the silicate investigations at Manchester, and has been made by many workers, especially by Pauling and his collaborators in the United States, and by Nagelschmidt and others in Germany and Great Britain. My discourse was a brief summary and comment on the work done and doing by others than myself.

W. H. BRAGG.

Royal Institution,
Albemarle Street,
London, W.1.
April 2.

A Shortened Method of Estimation of Mental Factors by Regression

A TYPE of problem of estimation with which one meets in the theory of mental factors is this: a team of n tests z_i ($i = 1, 2, \ldots, n$) has been analysed into r common factors $f_{0\alpha}$ ($\alpha = 1, 2, \ldots r$) and n specifics f_{1i}, all of which are normalized and uncorrelated, but otherwise unknown. The observed test-scores (in standard measure) can then, in matrix notation, be represented as follows.

$$z = M_0 f_0 + M_1 f_1,$$

where the column vectors z, f_0 and f_1 indicate the tests, the common factors and the specifics respectively. The matrices M_0 and M_1 whose elements are the loadings of the tests with the hypothetical factors, are regarded as known. When it is desired to estimate the common factors in terms of the test-scores, the usual regression method leads to the formula:

$$\hat{f}_0 = M'_0(M_0 M'_0 + M_1{}^2)^{-1} z, \quad \ldots \quad (1)$$

where $\hat{f}_0$ is the estimate of f_0.

If the number of tests, n, is large, the evaluation of this expression is very laborious, since it involves calculating the reciprocal of the n-rowed matrix $M_0 M'_0 + M_1{}^2$. However, according to L. L. Thurstone, the number of common factors, r, is in most practical cases much smaller than the number of tests; in these circumstances it is more convenient to use the formula:

$$\hat{f}_0 = (I + M'_0 M_1^{-2} M_0)^{-1} M'_0 M_1^{-2} z, \quad \ldots \quad (2)$$

in which now only the reciprocal of an r-rowed matrix is required.

Formula (2) is an extension to multiple factor analysis of a formula which Prof. C. Spearman has derived for the estimation of the 'general factor' g in the theory of two factors.

A more detailed account of this will be given elsewhere.

WALTER LEDERMANN.

University,
Edinburgh.
Feb. 10.

Points from Foregoing Letters

IN an investigation of the capture γ-radiation produced by protons in carbon, P. I. Dee, S. C. Curran and V. Petržílka find that there are two resonances. One of these, at 400 kv., is due to ^{13}C, the other, at 500 kv., is due to ^{12}C. The energies of the capture γ-radiations have been measured, giving for ^{13}C the value 2·6 Mv. and for ^{12}C the value 7·4 Mv. These values agree with those to be expected from the known mass values.

From energetics considerations, Dr. F. London concludes that a spatial model of liquid helium II such as that proposed by Frölich to explain the λ-transition point is not possible. The author describes, instead, a kinetic model in which each helium atom moves in a self-consistent periodic field formed by the other atoms. He calculates the specific heat of such a system by applying Bose-Einstein statistics on the very rough simplifying assumption of 'ideal gas' conditions. The author considers that his view may throw light on the large heat conductivity and the small viscosity of helium II.

The cross-section for the total nuclear photo-effect of the deuteron for 2·64 Mev. γ-rays has been determined by Dr. H. v. Halban, jun. The relative contributions of the electric and magnetic effects were separated by counting the number of photo-neutrons projected in the direction of the incident γ-ray and at 90° to this direction. The cross-section found for the magnetic effect is lower than would be expected from the capture cross-section of protons for thermal neutrons.

Among some 10,000 proton tracks obtained by using D—D and Li—D neutrons and photographed in a Wilson chamber, S. Kikuchi and H. Aoki have found only six pairs, a smaller proportion than formerly noticed, and only one sixth of the expected number on the basis of the 'neutro-electric effect.'

An unusual intense nitrogen afterglow has been produced by Prof. J. Kaplan at pressures higher than 10 mm. Its spectrum is rich in bands of the Vegard–Kaplan intercombination system and contains a strong line at 3470 A. which is tentatively identified as the hitherto unobserved trans-auroral line $^2P - {}^4S$. There is a fairly strong line at this wave-length in the light of the night sky. A search is now being made for the $^2P - {}^2D$ lines in the high-pressure glow. These should lie around 1·0373 μ and would be the nitrogen analogues of the well-known green auroral line.

Further investigations towards elucidating the structure of the anti-sterility vitamin E are reported by Dr. F. Bergel, A. Jacob, A. R. Todd and T. S. Work. From the fact that a synthetic coumaran derivative behaves similarly to β-tocopherol upon thermal decomposition and from surface film measurements carried out by Dr. J. F. Danielli, they conclude that β-tocopherol is a coumaran derivative.

Dr. J. W. Hes finds that the complete removal of carbon dioxide interferes with the oxidation-reduction power (as shown by the methylene blue reaction) in the case of heterotrophic cells, that is, bacteria and other low organisms which cannot synthesize proteins and carbohydrates from inorganic constituents. This explains the indispensability of carbon dioxide for the growth of such organisms.

Prof. Jan Smit and B. van der Heide report on experiments showing that milk-wool, made from milk-casein, is readily attacked by many kinds of micro-organisms, which may thus affect durability of textile products made from that substance. The dissolving action was likewise shown by sterile pieces of the milk-wool agar, on which the organisms were grown, and taken from places where the wool had been dissolved by an exo-enzyme. The enzyme was destroyed by heating the agar.

A study of the formation of the calcareous tube of the serpulid worm *Pomatoceros triqueter* by the late Frank A. Potts, reported by J. D. Robertson and Dr. C. F. A. Pantin, has shown that the source of calcium for the tube is probably the sea water. Tube building in this polychæte extends from March to September.

Research Items

'Bone Age' Man

THE ABBÉ BREUIL in *Antiquity* of March argues for a much more extensive use of bone in the earlier phases of the Palæolithic period than is at present conceded by archæologists. In the Later Palæolithic period, the technique of bone is already far advanced, and the implements must have had more ancient prototypes; but in fact the only Middle Palæolithic examples known of bone-working by means of attrition and scraping are few in number—rib-bones sharpened by rubbing, occasional awls similarly sharpened, and two large spear-points of the Upper Mousterian from Castillo and La Quina, to which might be added the anvil blocks and trimming tools discovered by Dr. H. Martin. Further, stone suitable for implements does not occur everywhere, and the technique of its working is a process of long development. Therefore some authorities postulate an age of bone and wood. Man in the dawn of the industrial phase would naturally take the remains of animals killed by him, horns, antlers and bones, to use against them. The long bones would make excellent clubs, while others in their natural state could be used for pricking and piercing, or as planes and hammers, either in the natural state or when broken by a pebble. Bones, however, gnawed by carnivores or rodents show marks suggesting human workmanship, which are apt to deceive the archæologist. The bone claimed to have been worked by Piltdown man is an instance in point. Evidence for the use of slightly modified parts of his victim by early man is afforded in the cave of Castillo (Santandar, Spain) and Choukoutien (Peking). The evidence of the horns of ruminants and deer antlers, of skulls or parts of skulls, of jaw bones and long bones, of shoulder, iliac and trunk bones from both sources suggest the belief, at least, that at some ancient epoch the use of bones may have been of more importance than the use of stone.

Ainu Marriage Ceremonial

IN an account of a traditional oration or song intoned or sung at an Ainu marriage which Dr. N. Gordon Munro collected from an Ainu learned in the lore of his people (*Man*, March 1938) he records the order of ceremonial in which the song was introduced. The song itself belongs to a class *Yai-kuru-e-karapa*, meaning personal speech-making, a term used only of an address on a felicitous occasion, but never for a funeral oration or at any other sad event. At a wedding, it is delivered by the father of the bride. On the occasion here recorded the song indicated that the daughter was an only child, and there is a hint of anxiety now relieved by the prospect of her children continuing the line. The bridegroom has been approved, more particularly as to his line of descent. Ainu society was matrilineal and rigidly exogamous, the evidence of descent of each group from an eponymous ancestress being furnished by a secret girdle, which no man dare examine and which it was taboo even to mention. It is a cord conventionally taken to signify a particular ancestral source, according to its length and consequently the number of times it is folded to make a girdle. Elderly women, who treasure their esoteric knowledge, decide whether the girdle of the man's mother bears testimony to a descent other than that of the girl. All preliminaries ended and marriage gifts exchanged (there is no bride-price), and the most revered and trusted Kamui Fuchi—spirit ancestress of all Ainu who comes to light in the hearth-fire—having been solicited, all is in order. The bridegroom has sent to the home of the bride material for the sacred brew, which takes a week to make from millet with ritual precautions. When the guests have assembled for the feast, the father makes a speech or recitative in poetic form, which preludes the ancient rite of handing the cup of the sacred brew to the bridegroom, who drinks half and gives the remainder to his bride. Should she refuse it there is no marriage. The bride takes the cup and raises it to the level of her forehead, swings it gently thrice to right and left, drinks, and then performs the characteristic feminine gesture of *rai-mik*, in which the forefinger of the right hand is drawn from that of the left hand up the arm and across the upper lip.

Influence of Circulation on Size of Blood Vessels

BY means of an indirectly illuminating microscope and a moist, warm chamber it is possible to study development of the vascular system in a living chick blastoderm still on its yolk for a period of seven days. This method was chosen by A. F. W. Hughes (*J. Anat.*, 72, Oct. 1937) to investigate the influence of the rate of circulation of the blood upon the diameter of the blood vessels. The rate of flow in the arteries and veins of the area vasculosa was determined by measuring the speed of the corpuscles in the margins of the vessels, and is termed the 'marginal velocity'. In the first ten hours the increase in diameter of the vessels may be 40 per cent per hour and the marginal velocity 4 mm. per sec. During the third and fourth days the marginal velocity drops to 1·2 mm. per sec. and the increase in diameter to 5 per cent per hour. Thus there is a correlation between marginal velocity and rate of increase in diameter of the vessels; the relationship, however, is not a simple mathematical one. In arteries, the mitotic rate of the endothelium is sufficient to account for the increase of diameter. When the veins are increasing rapidly in diameter, however, the mitotic rate of the endothelium is only sufficient to account for about one fifth of the increase in diameter. Since no noticeable increase in cell size is discernible, it is suggested that the remaining four fifths of the cells are supplied by the immigration of cells from the adjacent mesenchyme.

Crabs of America

MISS MARY J. RATHBUN completes her series of handbooks on American crabs in a fourth volume, "The Oxystomatous and Allied Crabs of America" (United States National Museum. Bulletin 166. 1937). The former volumes have dealt with grapsoid crabs (Bulletin 97), spider crabs (Bulletin 129) and cancroid crabs (Bulletin 152). All these works are based on an enormous amount of material and the whole is exceedingly valuable. Carcinologists are fortunate in having this complete work by one of the greatest authorities on the subject. The present volume includes Gymnopleura, Oxystomata and

Dromiacea; also the Haplocarcinidea, the position of which in the Brachyura is uncertain, and one single example of *Geryon* (Brachygnatha) omitted previously from the volume on Grapsoids. The Dromiacea are still regarded as belonging to the Brachyura in spite of the fact that the larvæ differ entirely from any brachyuran zoea. The Oxystomata are the largest group represented and occupy the greater part of the volume (pp. 75–258). In this sub-tribe are many very interesting forms, some of peculiar shape, some so exactly resembling the pebbles in which they live that it is difficult, if not impossible, to detect them in their natural surroundings. The Calappidæ with their large chelæ which cover the ventral surface are also included here. The 86 plates, mainly from photographs, are good and clear.

Indian Brackish Water Fauna

N. Kesava Panikkar and R. Gopala Aiyar (*Proc. Ind. Acad. Sci.*, 6, Nov. 1937) have investigated the fauna of the brackish waters in the neighbourhood of Madras, particularly in regard to its relation to its habitat. The temperature of the water varies during the year from 25·0° C. to 29·6° C., its *p*H from 8·48 to 9·15, its salinity from 16·91 to 30·44 per mille. The change from marine to brackish water conditions is somewhat abrupt. Ninety-two species of invertebrates, eighty belonging to typically marine groups, are recorded, and this excludes Protozoa and Rotifera. The majority of the fifty-four fishes recorded are more or less permanent inhabitants; seven freshwater species and a few casual or seasonal migrants comprise the remainder. The fauna on the whole is typically marine. The animals are discussed from the point of view of their ecology and adaptation to their environment, which is described in detail. The vertical and regional distribution of the organisms is described, and there is a discussion of the general problems of the biology of animals in brackish water in the light of the facts brought forward.

Osmotic Values of Plant Tissue under Snow

DURING the British East Greenland Expedition of 1935–36 under the leadership of Dr. L. R. Wager, Dr. and Mrs. H. G. Wager carried out observations throughout the year upon the osmotic values of typical plants in Kangerdlugssuak, East Greenland. The osmotic values were determined by a plasmolytic method using sections or stripped portions of the epidermis and cane sugar solutions. Some of the species examined showed a sharp rise in osmotic value in late autumn, probably associated with the falling temperature both directly and indirectly, through the fact that the soil water was thus rendered unavailable. The most interesting result is the fact that five plants—two species of *Salix*, *Empetrum*, *Viscaria* and *Cassiope*—show a marked fall in osmotic value during the winter, whilst buried under the snow. The authors suggest that this is probably associated with a change in the water balance. Under the snow the air is continually saturated with water vapour and the water shortage in autumn, very clearly shown in some species by the shrunken protoplasts when examined in oil, no longer exists, the cells slowly saturate with water and the osmotic pressure falls. Comparison between the osmotic values of some of the same plants grown throughout the seasons in Dublin suggest, however, that the group of factors determining the seasonal changes of osmotic pressure is very complex.

Disease of Australian Pines

A PROGRESS report for 1936–37 entitled "Needle Fusion of Species of *Pinus* in Southern New South Wales" by W. V. Ludbrook has been issued (Melbourne, 1937) discussing the disease known as 'needle fusion', 'fused needle', or 'curly needle', which is confined to Australasia, being important chiefly in Queensland, Tasmania and the coastal plantations of New South Wales. Investigations appear to show that it is severe only when the soil conditions are unsuitable to the trees planted, a case which has other parallels elsewhere with introduced exotics. There is no evidence that it is infectious, though the cause of the disease is still unknown. It is said that the commercial value of severely affected trees is permanently destroyed. Diseased trees exhibit varying degrees of stunting, die-back and needle abnormality, but are rarely, if ever, killed by the disease. The symptoms commonly appear 3–7 years after the trees have been planted. The majority of the species of *Pinus* commonly grown for afforestation in Australia are susceptible, *P. pinaster* being the chief exception. *P. caribea* appears to be relatively resistant. It is said that there is little or no chance that the disease will cause appreciable loss in plantations where the soil and climatic conditions are satisfactory. In Queensland, climatic conditions are very different from those where the investigations were made, so that the conclusions arrived at may not be applicable.

Fusarium culmorum on Wheat

THE fungus *Fusarium culmorum* has been described as the cause of various diseases of wheat, but modern investigations do not incriminate it strongly. G. Samuel and F. J. Greaney have, in fact, isolated it from healthy, high-yielding crops in three localities in the south of England (*Trans. Brit. Mycol. Soc.*, 21, Pts. 1 and 2, 114–117; 1937). One crop obtained the gold cup at the Bakers' Exhibition in London, yet in spite of this undoubted hall-mark, its roots and stems harboured *F. culmorum*. Very numerous isolates of the fungus were all mildly pathogenic under greenhouse conditions, and there would appear to be other evidence that the fungus really does cause damage in the northern parts of Great Britain. Such findings emphasize the need for greater development of the ecological side of plant pathology. A close alliance of laboratory studies and field estimations over a wide area is absolutely necessary for the correct evaluation of any host-fungus relationship.

Oceanic Sedimentation

FROM the stratification of the bottom samples collected during the *Meteor* Expedition, Schott, in 1935, calculated the average rate of deep-sea sedimentation at 1 cm. per 1,000 years. This estimate was based on the reasonable assumption that 20,000 years have elapsed since the climate was considerably colder than at present. In an interesting study of the problems raised by such rapid sedimentation, Ph. H. Kuenen (*Amer. J. Sci.*, Dec. 1937) points out that Schott's estimate appears to imply a total thickness of deep-sea sediments amounting to about 17 km. This, in turn, implies denudation of the continents of about 40 km., which is evidently far too high to be acceptable. Two modifying factors have to be considered, however, namely, compaction of the sediments, and the steady production of eruptive rocks throughout geological time. Appropriate

estimates of the effects of these factors then bring Schott's figures into close agreement with the results of other denudational statistics. It is concluded that the thickness of deep-sea deposits may be of the order 5–6 km. The bearing of such a thickness on isostasy, temperature at the lower surface of the oceanic crust, seismic propagation, the thickness of the continents, and the mechanism of continental drift is discussed. Kuenen shows that if South America drifted westwards for 3,000 km., the piled up oozes would, after complete isostatic compensation, form a mass equivalent to a plateau 200 km. broad at sea-level. Actually, the continental slope is there one of the steepest in the world and is fronted by deep-sea troughs. Evidently the problem of oceanic sedimentation is involved with others which cannot yet be easily solved.

Origins of Magmas

In a stimulating paper on "The Origin of the Pacific Magma Types in the Volcanic Inner-arc of the Soenda Mountain System" (*De Ingenieur in Ned.-Indie*, No. 1; 1938), R. W. van Bemmelen reaches some petrogenetic conclusions of far-reaching importance. He points out that three different ways of magma generation may now be distinguished: (1) differentiation of a parental magma (primary or juvenile magmas); (2) magmatization of pre-existing crustal rocks by ascending emanations from the substratum (palingenetic magmas, now becoming more familiar as rheomorphic magmas); and (3) hybridization or contamination of juvenile or palingenetic magmas by assimilation of foreign material (syntectic or mixed magmas). On the basis of geological field observations, together with petrological and petrochemical investigations, in the area under review, the author comes to the conclusion that there are few direct indications of (1), whereas (2) and (3) are of great importance for the origin of calc-alkali or Pacific magma types. The observations strongly point to the possibility that at least part of the various types of Pacific igneous rocks are *not* the product of gravitational crystallization differentiation of a gabbroic parent magma, as has been commonly assumed, but that they are the result of the ascent of magmatic emanations, containing mainly silicon, aluminium and alkalis, whereby the sialic crustal rocks became locally magmatized. A valuable feature of the paper is the review which it contains of the recent literature relevant to the subject of magma formation.

Impact Stresses

In a paper read before the Scottish Section of the Institution of Mechanical Engineers at Glasgow on March 3, it was demonstrated that stresses caused by impact loads may and do differ materially from those calculated on the assumption of statical equivalence. The subject of the research—described by Mr. R. N. Arnold under the title "Impact Stresses in a Freely Supported Beam"—was a portion of railway rail, 8 ft. span, and the bending stresses induced were found to be 20 per cent higher than those calculated on this assumption. The beam was subjected to impact loads by dropping weights of magnitude up to 470 lb. from different heights and at intervals of 4 in. along its length; records of its deflections were made by means of a scratch extensometer, the construction of which is described. These show the occurrence of 'sub-impacts'—the weight, in some cases, striking the rail five times in what appeared to be a single impact. At the centre of the beam the deflections are seen to be initially positive, but at distances of 16 in. and more from the centre they prove to be initially negative and to become positive as the impact proceeds, thus showing a distinct divergence from the conditions of static bending. The analysis of the results obtained in this way and also by the use of thin pieces of paper inserted between the rail and the falling weight leads to the conclusions that impact effects, even in comparatively simple settings, are in general much more complicated than is supposed, and that while the ordinary methods give fair approximations for deflections, the errors which they introduce in the bending moments and stresses are excessive. This research had particular reference to the impact loads to which railway rails are subject due to such causes as non-circular wheels, rail irregularities, joints and crossings and to the trouble experienced with fatigue cracks. These grow internally in the head of the rail and are especially dangerous because their existence may be quite unsuspected until fracture occurs. Similar internal fissures have been produced by prolonged repetitions of a rolling load on a rail, and wheel impact load rather than bending moment has been indicated as the stress-determining factor. The results of the present series of tests are held to have exhibited the complexity of impact effects and the probability that the actual loads may be much more severe than are predicted by the usual approximate theories.

State of the Outer Planets

Dr. Harold Jeffreys has recently published a note on the state of the outer planets (*Mon. Not. Roy. Astro. Soc.*, **98**, 3; Jan. 1938) in which he corrects certain misinterpretations of his previous papers on the cold conditions prevailing on the outer planets. His paper is largely suggested by Mr. B. M. Peek's paper (*Mon. Not. Roy. Astro. Soc.*, June 1937), where doubts are expressed regarding the deep atmosphere and thick layer of ice on Jupiter. In Dr. Jeffreys's second paper (*Mon. Not. Roy. Astro. Soc.* **84**; 1924), he pointed out that an explanation of the observed radiation of Jupiter and Saturn—appreciably larger than it was possible to explain by solar radiation—would be possible if the planets possessed 1,300 times as much uranium per unit surface as is present on the earth. This, however, was not suggested as a serious explanation, as some appear to have thought. Another alternative explanation was departure from black-body radiation, made some two years later, but he does not consider that this is the correct one. He now suggests that if the surface temperature of Jupiter is about 150° absolute and we allow for solar radiation, the planet would have had time to lose 5,000 calories per gram—not an unreasonable amount. With suitable internal conditions the original heat may explain the difference between the observed and calculated radiations. Dealing with the thick ice layer, he does not consider that this implies cold interior conditions, because if the temperature gradient fell below some degrees per kilometre, convection would cease, cooling would be negligible, and a high central temperature would be possible. Dr. Jeffreys also attaches some importance to Wildt's suggestion that the ice would be in the form of Bridgman's high-pressure modification, Ice vi, which can exist at fairly high temperatures.

Teaching of Technical Optics

THE teaching of optics may be divided into four sections: (1) physical optics; (2) optical computation and design; (3) ophthalmic optics; (4) practical optics—glass grinding and polishing.

Physical Optics. The first of these sections is included to a greater or less extent in the teaching of physics in nearly all schools, universities and technical colleges. As 'light' it is included among the subjects that may be offered in the school certificate and matriculation examinations. To more advanced stages it is treated in the courses for the science degree and for the honours examinations in physics at the universities. All these courses are so well known that they need be no further described.

Optical Computation and Design. The second section is an exceedingly important one, as upon the ability to carry this out depends our future progress in the construction of new forms of instruments for surveying, astronomy, gunnery (including such things as range-finding and air defence), photography and microscopy. The actual number of men required for these computations is not large—indeed it is exceedingly small in comparison with the numbers of engineers or chemists for which there is a demand; their importance, however, is not to be measured by their numbers but by the value to the nation of the work they do. The demand for such men has only gradually arisen in (say) the last fifty years. Until then, lenses both for the microscope and for photography had to a large extent been devised and produced by methods of trial and error by practical men, who had only a general acquaintance with optical principles; their calculations were mostly concerned with first-order quantities, and their corrections were the result of their own long experience of the results of changing one or other of the surfaces. This experience in the hands of such men as Andrew Ross and Tom Powell resulted in the production of lenses of excellent performance, but each lens had to be individually tested and adjusted. Then such computers as Schroeder, Hasselkus, Conrady, Booth, Aldis and Dennis Taylor in Great Britain, and Abbe, Rudolf, Goerz and others abroad, showed that there were great possibilities of improvement in the design of lens systems by the application of the theoretical work of Coddington, Seidel and others, and by the systematic computation of the paths of rays through a lens system. As a result, such firms as Zeiss now employ men who spend their whole time in the computation of lenses for optical instruments of all kinds.

The sudden large demand for optical instruments caused by the Great War and by the closure of the foreign supply of such instruments, made it imperative that special courses of training should be provided. Courses were already in existence at the Northampton Institute, set up first by Dr. C. V. Drysdale and later carried on under S. D. Chalmers and since his death in 1919 by H. H. Emsley, but these classes were sparsely attended and did not carry their students very far. A special Department of Technical Optics was therefore established at the Imperial College of Science under Prof. Frederick J. Cheshire with Prof. A. E. Conrady in the chair of optical designing and computing and with L. C. Martin as lecturer. Somewhat later, Prof. A. F. C. Pollard was appointed to the chair of mechanical design of optical instruments. In the first few sessions, the demand for trained computers made the classes abnormally large, but since then they have averaged an output of some half-dozen a year. They cannot expect to be larger, as the number of firms requiring such men is necessarily small; for example, in Great Britain there are only four firms making microscopes—Baker, Beck, Swift and Watson, and four making photographic lenses—Cooke, Dallmeyer, Ross and Taylor, Taylor and Hobson. To these must of course be added firms making surveying, navigating and astronomical instruments, and the army and navy have their own staffs for the design of the special instruments required for warfare; but when allowance is made for all these the total numbers still remain comparatively small, though nevertheless of exceeding importance.

The course at the Imperial College is a two-year one, usually taken as by post-graduates. It includes the theory, design and testing of the fundamental optical systems from both the optical and the mechanical points of view with practical work in all branches. Since their establishment, more than six hundred students have entered for these courses and must have proved of very great value to the industry. The research work of the College, which has been carried on both by students who have continued on after the completion of their course and by the members of the staff, has covered a wide field. Of great importance were Conrady's investigations into the tolerances allowable in an optical system (published in the *Monthly Notices of the Royal Astronomical Society* and later embodied in his "Applied Optics and Optical Design"). Other papers, on ultra-violet transmission of materials and the ultra-violet microscope, the electron microscope, on colour vision and colorimetry and on similar subjects amount in all to more than a hundred and fifty—no inconsiderable output for one department in a comparatively short period.

Some small amount of similar work has been done at both the Northampton Polytechnic Institute, London, E.C.1, and the School of Technology in Manchester, but more in the way of individual work by advanced students and by research than as systematic training, as it has not been worth while to run special classes for the small number of students who wished to attend in any one year.

Ophthalmic Optics. In the third section of optical teaching, ophthalmic optics, there are much larger numbers of students. For these, special examinations were set up by the British Optical Association in 1895 and by the Spectacle Makers Company a year or two later. Before entering for the examinations of the former body, students must have passed a matriculation examination or its equivalent; for the latter they have to sit for a preliminary examination in similar subjects. For the certificates of both bodies the students have to pass in elementary optics; the general structure and functioning of the eye; practical sight testing for the prescription of spectacles; and in workshop practice—lens finishing and mounting and frame making and bending. In order to ensure

satisfactory training for the examination, the B.O.A. has 'recognized' certain schools which have been inspected to ascertain that their equipment, staffing, and courses are satisfactory. These schools are mostly in the technical institutes in such towns as Manchester, Edinburgh, Glasgow, Bradford, Cardiff, etc. The largest classes are those at the Northampton Institute, London, where last session more than two hundred and thirty attended organized courses in addition to some sixty who took special courses or individual classes in optics. In Manchester in the same session twelve students were taking full-time courses and about forty were taking part-time courses for these examinations. In the other schools the numbers are of the order of a dozen students in the session. In addition to the optical training in these schools, arrangements are made in all cases for the students to attend some form of hospital course in order to enable them to recognize diseases of the eye, to ensure that patients so suffering shall be sent to obtain proper treatment.

Practical Optics. The fourth section of optical training, practical optics, is provided to a limited extent at all the 'recognized' schools, since it is included in the training of the sight-testing optician, who is expected to be able to grind, polish and edge a lens for a spectacle frame; but it is also arranged as an independent course both at the Northampton Institute and at the Manchester School of Technology. These special courses are planned for workers in optical factories; the students attend on three evenings a week for instruction in drawing, in optical calculations, and in actual lens- and prism-grinding and polishing. The industry so far does not seem to have appreciated the potential value of these classes, as there were less than ten students at either of the schools last session. In spite of the large use of machinery for the grinding and polishing of lenses and prisms, the very exact workmanship required in some cases (roof-prisms, for example, have to be worked to an angle which is correct within two seconds of arc) still necessitates hand finishing; for this and similar work, as well as to enable the men to use the machines in a more intelligent and less 'rule-of-thumb' manner, such classes should surely be of very great value.

Inauguration of the German State Council for Research

IN March of last year, the foundation of a new State Council for Research ("Reichsforschungsrat") was announced in Germany by the Minister of Education, Herr Rust. Within ten weeks the fourteen departments of the research organization were formed. In December last a handsomely printed quarto publication describing the Council and its purposes was issued with No. 23 for the year 1937 of the Official Gazette of the German Ministry of Learning, Training and National Education (Amtsblatt der Reichs-Ministeriums für Wissenschaft, Erziehung und Volksbildung). It is entitled "A Celebration of German Learning" (Ein Ehrentag der deutschen Wissenschaft, 25 Mai 1937).

The publication sets out the system on which research is to be organized and the principles on which it is conducted in the Third Reich. It is illustrated with scenes of the inaugural ceremony and with large portraits of the Führer, the Minister of Education, the president of the new Council, Artillery-General Professor Dr. K. Becker, his acting deputy, the vice-president, Dr. O. Wacker, and the directors of the various departments. Fourteen of these departments, all of a definitely technical character, have been established. The speeches of Herr Rust and of Prof. Becker are set out in large type and are followed by detailed records of the career of each director of a department.

In his address, Herr Rust directed attention to his ready action and indicated the need for the establishment of the Council. "The Council," he said, "is initiated at a moment when the German people is preparing, in a manner hitherto unprecedented and by an unexampled expenditure of its utmost effort, to win its rightful foundations of existence, independent of its environment. . . . Not long ago many of us felt that learning (*Wissenschaft*) was too aloof from the great decisions of our time to co-operate in the great struggle of the German people. But the course of German history has itself brought this idyllic attitude to an end and with it has ended also certain idyllic forms of scientific work. The Nazi Revolution summoned science to the decisive battle."

Herr Rust then turned to the question of the freedom of science and of learning: "Complete freedom of opinion and judgment," he said, "are not marks of a truly free science, but rather of an estrangement of the spirit from the eternal forces of Nature and of history. . . . Freedom is assured to science neither by its abstractness nor by its independence of current events. . . . It is rather the hopes of the German people and of the Nazi State in the share of science in the Four Year Plan . . . that give proof of the recognition of the freedom of science.

"If the Nazi State calls on German science to co-operate in the Four Year Plan, it is not because it anticipates the findings of science but because the first task of science will be to give us those materials which Nature has denied us. Such a task can only be accomplished by free science. For science is unfree if her findings be dictated by an unscientific force, but she is free if she sovereignly masters those problems which are posed to her by life. . . . With the foundation of this Council no new principle of scientific behaviour is introduced. . . . What is new is the determinate and planned co-operation of technology and of science for the self-sufficiency of the German economy."

The president of the Council, General Becker, spoke of the reduction in number of the independent centres of research in Germany with the object of concentrating research on more immediate ends. He then turned to consider the way in which the new Council would further the unification of research on methods of preparing raw materials and on their employment. Here, he pointed out, a special position was occupied by the Kaiser Wilhelm Gesellschaft zur Förderung der Wissenschaften.

"The status of the Kaiser Wilhelm Gesellschaft," he said, "will not be disturbed by the new process of

organization. Those in authority regard its maintenance as necessary not only because of the respect which it enjoys abroad but also for the purpose of linking research with industry. The necessary co-operation between the State Council for Research and the Kaiser Wilhelm Gesellschaft is for the present guaranteed; first, by the common supervision of both bodies by the Reichsminster (Herr Rust), secondly, by the appointment of the directors of two of the Kaiser Wilhelm Institutes as heads of Departments of the State Council for Research, and finally by my own membership of the Senate of the Kaiser Wilhelm Gesellschaft. Later it will be essential, by suitable measures, to bring the directors of all the Kaiser Wilhelm Institutes into closer relations with the State Council for Research. The Ministerial decree founding the Council," he added, "designates the furtherance of the Four Year Plan as one of the Council's most important tasks."

The careers of the heads of all departments of the new Council are set forth in the publication, those of the president and vice-president being stated as follows:

"*Artillery-General Professor Karl Becker.* Born 1879. From 1900 Artillery Officer. 1906–14 in the Military Technical Academy and active as referee in ballistics. 1914–16 on active service in charge of a 42 cm. battery and then until the end of the War ballistic expert of the Artillery Investigation Commission. From 1919, ballistic expert in the Armaments Office and from 1926 director of its Projectiles and Munitions Department. Since 1932, as director of the Munitions Office Investigation Committee, he has been responsible for the entire technical developments of the Army. In 1933 he became professor ordinarius of military technics, physics and ballistics at the Technische Hochschule in Berlin."

"*Staatsminister Dr. Otto Wacker.* Vice-president of the State Council of Research. Head of the office for Learning (*Wissenschaft*) in the Ministry of Learning, Training and National Education. Born 1899. During the War he was a 'front fighter' on the western front. After the War he studied architecture at the Technische Hochschule at Karlsruhe. Since 1925 he has studied German literature and history at Freiburg, where he took his doctorate. During the revolutionary period he became a district leader (*Kreisleiter*). He also wrote for the Baden journal *Der Führer*. In 1933 he became *Kultus* and Education Minister of Baden. With the nationalization of justice in 1934, he became Minister of Justice for Baden. He is also an SS Commander (*Oberführer*)."

The fourteen departments already organized by the Council are as follows: (1) Physics, including mathematics, astronomy and meteorology; (2) Chemistry and physical chemistry, under the direction of General Becker himself; (3) Power materials; (4) Organic industrial materials, artificial products, rubber, textiles, fats, cellulose; (5) Non-ferrous metals; (6) Geology, including mineralogy and geophysics; (7) Agriculture and general biology, including zoology and botany; (8) Forestry and timber research; (9) Military science and technics, under General Becker himself; (10) Electro-technics; (11) Mining and smelting; (12) Iron and steel; (13) Medicine, including race research and race biology; (14) Military medicine.

Medical Research in Canada

Medical Research Committee

A COMMITTEE to study the organization of medical research in Canada has been appointed by the National Research Council. This action was taken on the recommendation of a nation-wide conference on medical research held in Ottawa recently, which was attended by representatives of all the medical schools, organizations and institutions concerned in medical research, including the provincial departments of health, the Department of Pensions and National Health, and the National Research Council. Sir Frederick Banting has been appointed chairman of the new committee. The president of the National Research Council, the deputy minister of the Department of Pensions and National Health, the president of the Canadian Medical Association, and the president of the Royal College of Physicians and Surgeons of Canada are to be *ex-officio* members of the committee. To complete the personnel of the committee invitations have been extended to twelve distinguished members of the medical profession who have a comprehensive knowledge of Canada's requirements in medical research.

It has been suggested by many members of the medical profession that the formation of this committee on medical research under the National Research Council might well be a first step towards the formation of a medical research council for Canada similar to that which exists in Great Britain. Commenting on this suggestion, Major-General McNaughton, president of the National Research Council, speaking at the conference, said that "the National Research Council is approaching the problem of organization of medical research at present as a preliminary measure only. When a purely medical research council becomes necessary, there will be no opposition whatever from the National Research Council. In fact, the National Research Council will give every assistance possible in order to help a movement that in the opinion of the Council is very important for the welfare of the people of Canada."

The immediate purpose of the committee is defined in the terms of reference, which are: (*a*) to receive suggestions for requirements in respect of medical research and in matters related thereto; (*b*) to consider by whom the investigations required can best be carried out and to make proposals accordingly; (*c*) to correlate the information when secured and to make it available to those concerned; (*d*) to do such other things as the committee may deem advisable to promote medical research in Canada.

The conference agreed that the scope of the new committee's activities should not be limited to particular subjects, but that it should be empowered

to investigate the whole field of medical research in Canada. One of the first steps to be taken by the committee will be to make a survey of the work in progress at various centres to determine how the activities of the various institutions concerned may be developed to the best possible advantage.

A remarkable record of individual research achievements was revealed in the prepared statements presented at the conference, but the need of bringing the available information together through a central body which could then make it more readily accessible to all concerned was stressed by nearly every speaker. The new committee undertakes its task with the full support and under the direct leadership of the medical profession as a whole in Canada. Results of far-reaching importance are expected in the planning and co-ordination of medical research that will be possible through this new committee. Better dissemination of information regarding the multitude of projects that are being carried on by skilled workers in the hospitals and laboratories of the Dominion will greatly enhance the opportunities of the research workers to make their efforts count.

Progress in Road Research*

ONE of the interesting features of the report of the Road Research Board (director of research, Dr. R. E. Stradling) recently issued by the Department of Scientific and Industrial Research is that which concerns the method of studying the problem of skidding by means of texture prints. These are obtained by inking a portion of the actual road surface and rolling over it a perfectly smooth tyre which then impresses on a sheet of paper an exact record of this portion of the road surface. The object is to study the texture of the surface of a road in order to ascertain its relation to the skidding resistance of the road and to its wearing properties.

The importance of the method can be understood from the statement made in the report that the skidding characteristics of road surfaces are largely determined by the total area of contact between tyre and road and by the number of individual isolated areas of contact into which the total area is divided. In order that, when the road is wet, the liquid on it can escape as the tyre rolls over the road, these small areas of actual contact must be surrounded by channels of adequate size. If the channels are too small, these small areas of contact will, in effect, be merged into one another and the surface will behave as if quite smooth. "An examination of texture prints taken from roads known to be slippery has shown", says the report, "that on these the tyre makes contact with the road over almost the entire area of the ellipse of contact while the number of individual contacts in this area is small". On the other hand, where the sideway force coefficient is high, the proportionate area of actual contact is found to be less while the number of individual areas of contact is much higher. The same is regarded as true of tyre-tread patterns.

In two other directions, the road texture print is an aid to the study of surface problems. By their means the seasonal changes in the slipperiness of roads are being more closely investigated. These, it is believed, depend largely on changes of the surface texture. Then, again, apart from the question of slipperiness, a series of prints is of value in exhibiting the progressive wear of a road surface and of enabling this and other surface changes to be recorded and followed.

The motor-cycle and side-car equipment described in previous reports continues to be employed on skidding tests and is noted as having been employed on surfaces prepared of cast-iron blocks, ordinary wood blocks and special blocks. A sharp fall in the value of the sideway force coefficient as from dry to wet conditions is very noticeable in the results. The higher powered machine now available permits of tests at speeds from 30 to 50 miles an hour, and it would appear that while, on most surfaces, the coefficient tends to reach a steady value in this range, on some there are indications of a continued fall and therefore of increased risk of skidding.

Specimens of mud from surfaces giving low skid coefficients are being studied and their lubricating properties compared with those of water in order to determine to what extent this agency affects slipperiness. The report briefly discusses the question whether mud films on a road during a fog produce a specially slippery surface, and the conclusion tentatively reached is that, from the several points of view quoted, the tendency is towards increased slipperiness.

Tests of road roughness by the special vehicle designed for the purpose and capable of detecting and recording irregularities of more than one fifth of an inch and of integrating them, show a total irregularity, on the best roads, of 75–85 inches a mile. Main roads commonly give 100–250 inches, and very rough roads 500–800 inches a mile.

In investigations on the durability of road construction by means of the full-size lorry driven round a track of 55 ft. radius, experience indicates the desirability of correlating these trials more closely to actual road conditions. In conjunction with a traffic census, records of the periods of wetness and of dryness will afford valuable information. Instruments have been devised for this purpose, the method employed to detect whether the road is wet or dry depending on the fact that the electrical resistance of the film of moisture on the road, measured between two contact strips 3 ft. long and 18 inches apart, is of the order of one fifth megohm when the road is wet, and some 50 megohms when visibly dry.

Other lines of investigation include the impact forces to which traffic subjects a road, the causes of failure of embankments and cuttings in wet seasons, tests of road materials and experiments on the aggregate vibration method of concrete control. An extensive trial of this method is being made by the County Engineer of Surrey in the construction of the Mickleham By-Pass Road.

* Department of Scientific and Industrial Research. Report of the Road Research Board, with the Report of the Director of Road Research, for the Year ended 31st March, 1937. Pp. viii+120. (London: H.M. Stationery Office, 1937.) 3s. net.

Water and the Plant

PROF. E. J. SALISBURY delivered the Masters Lectures of the Royal Horticultural Society in March of last year. He spoke on "The Plant and its Water Supply", and the text is now published in the Society's *Journal* (62, Pts. 10 and 11, Oct. and Nov. 1937). It provides a synopsis of present-day knowledge which should be in the hands of every teacher and research worker in botany.

Prof. Salisbury ministered to the modern necessity for defining what is meant by water, for he considered some of the botanical implications of heavy water. A plant does not have a uniform water requirement throughout its period of growth, and the work of B. N. and B. R. Singh was quoted to show that seedlings and plants about to flower have greater demands than at other stages. Soil conditions naturally play a large part in the supply of water, and the physical forces which are active therein were reviewed in a succinct manner. Recent work upon the extent of root systems, the suction pressures required to transfer water from the soil to the plant, the appearance of osmotic gradients within the root and shoot, the numbers and behaviour of stomata, and the occurrence of hydathodes and nectaries, was marshalled to provide a basis for estimation of a plant's balance of water.

Several external factors may affect these processes. The root system may be diminished by competition or lack of phosphate in the soil, and shoot development is dependent upon proper extension of the root. The intake of sufficient mineral matter and of the rarer essential elements is also conditional upon an adequate area of absorption. It is interesting to note that gold is now enumerated among the elements present in small quantities in the tissues of some plants. It is found in the ash of *Equisetum arvense*, but not in amount sufficient "either to justify its cultivation, or even compensate us for its presence". Plants may also take in some water through the leaves, and the recovery of wilted shoots during the night is probably due very largely to this agency.

The mechanics of water transfer along the stem was also passed under review by Prof. Salisbury. Rates and pressures of the transpiration stream were enumerated. Investigations by Keinholz and by McDougall seem to show that a woody tree is not a rigid system, for the trunk contracts slightly during the day, and recovers at night.

The numbers of stomata upon the leaf of a plant may vary with soil conditions, being crowded when the plant grows in a dry situation, and sparser under wet conditions. Some plants grow better in dry air, while others flourish more in a moist atmosphere. The rate of water loss also depends upon the difference in temperature between the leaf and the surrounding air, whilst wind, of course, increases transpiration.

One cannot escape the conclusion, on reading Prof. Salisbury's lecture, that botanical research owes a great deal to the simplest methods. Measurements of temperature, humidity, water contents and organic matter contents, leaf areas and root lengths, contribute to a very convincing philosophy of the water relations of a plant, and also provide much practical knowledge which can be used directly by the gardener.

Telegraphy and Telephony

Progress in the General Post Office

AT the Institution of Civil Engineers on January 11, Sir George Lee, engineer-in-chief to the Post Office, read an instructive paper on recent and future developments in telephony and telegraphy and on the conveyor and machine systems in postal work. The aim of the developments is reduction of costs or higher precision in transmission. The change in the increase in the number of telephones from 73,000 per annum in 1931, to 250,000 per annum in 1937, and the 50 per cent increase in the traffic in telegraphy due to the new tariffs, shows that such steps are desirable.

It was pointed out that by carrier-cables the speed of transmission in telephony has been increased from about 20,000 miles per second to six times that amount. The use of these cables also reduces the difficulties met with owing to the fact that waves of different frequencies travel with different velocities. It is fortunate that the ear is very accommodating both for electric wave 'echoes' and 'phase delay'. It is interesting to find that the beams of light which constitute a television picture, in order to be portrayed accurately and quickly, require, at the present time, a band width of 1,600,000 cycles, whilst commercial telephony only requires 2,400. Circuits for music require 9,000. Thus the new 'coaxial' cable is expected to carry 400 telephone conversations simultaneously, although it only provides one television channel.

Sir George referred to radio telephone communications by the use of ultra-short waves. Examples were given of commercial communications within the optical range, in the radio telephone system across the North Channel between Scotland and Northern Ireland. This is done by using two stations well above sea-level. A distance of approximately 36 miles is traversed, the path being entirely optical. As an example of a service working over a non-optical range, the radio telephone service between England and Guernsey was cited. It was attempted at first to cover a range of 105 miles, the optical range being only 45 miles. With this arrangement it was found that as late autumn changed into winter, the received energy was only about one thousandth of that received during the summer. A change in the stations selected reduced the distance to 85 miles; this worked satisfactorily, the working range being 1·73 times the optical distance.

Science News a Century Ago

Human Temperature in Different Climates

AT a meeting of the Academy of Sciences on April 9, 1838, reported in the *Gazette Médicale de Paris* of April 21, MM. Eydoux and Souleyet reported their observations on the men belonging to the crew of the *Bonite* of different ages and temperaments but always leading the same kind of life and engaged in much the same kind of occupations. Their observations were carried on every day at the same time (3 p.m.) from their arrival at Rio de Janeiro until their return to France. These observations, which amounted to more than a thousand, showed that human temperature rises and falls at the same time as the external temperature, though much less rapidly, as it is easy to imagine. It falls rather slowly on passing from a hot to a cold country, but after leaving a cold region for a tropical one it rises much more rapidly. This upward or downward movement is more or less marked according to the individual, but the extremes are fairly close to one another, and the average of the differences observed in the temperature of the human body for a difference of 40° C. in the temperature of the external air was only about a degree in the men under observation.

The Royal Astronomical Society

AT a meeting of the Royal Astronomical Society on April 13, 1838, several communications were made. The first of these was "On the Correction of the Mean Distance, Eccentricity, Epoch and Longitude of the Aphelion of the Orbit of Venus, by Errors of Heliocentric Longitude derived from the Cambridge Observations of the Years 1833, 1834 and 1835 and the Greenwich Observations of 1836". The author of this paper was the Rev. Robert Main (1808–78) who had become chief assistant at Greenwich in 1835 and was afterwards Radcliffe observer at Oxford.

Another paper, entitled "Times of Emerson of the first and second Satellites of Jupiter observed at Greenwich Hospital School, April 9, 1838", was by Edward Riddle (1788–1854) who was mathematical master at the School from 1821 until 1851. "These phenomena," said Riddle, "deserve notice and are here recorded, merely from their happening within so short a time of each other, and from their having been observed earlier in the evening than the superintendent of the *Nautical Almanac* anticipated that they could be seen with advantage in this neighbourhood."

German Scientific Periodicals

THE editor of the *Athenæum* had apparently asked a correspondent in Germany to give a review of the progress of art and science in that country, and accordingly a communication was sent from Dresden which was printed in the journal on April 14, 1838. "Your wishes", the writer began, "are easier expressed than complied with; however, I will do my best to give you a sketch of the intellectual world of Germany. . . . In no part of Europe is the number of periodicals devoted to science, art and literature, so great as in Germany. . . . In the scientific and medical journals, of which about eighty exist in Germany (forty-one being exclusively devoted to physiology and medicine) many subjects of importance are under consideration and discussion. Animal magnetism, somnambulism, and even the histories of people possessed with devils occupy many pens . . . the works on animal magnetism, which have lately appeared from the pens of Professor Hensler and Dr. Bork . . . are reviewed in Gersdorf's Repetorium and other journals. Dr. Bork asserts that during the last nine years he has cured no less than two thousand diseases through the influence of animal magnetism. In the writings of two other medical men, the greater number of illnesses, particularly of married people, are attributed to disharmony in the magnetic influences; and however absurd such opinions may be thought in England, it is beyond question that many educated Germans have faith in them. . . . Another therapeutic novelty . . . is the *cold water* system. . . . The press is continually producing works advocating cold water, internally and externally, as the grand remedy for all disorders."

. . . . .

"A periodical of somewhat higher pretensions than any of the preceding is the 'German Quarterly' just published by Cotta, of Stuttgart. . . . This work is to occupy new ground, and supply a void long felt to exist. A point of union was wanting in Germany, where new discoveries and their practical utility . . . could be immediately discussed and appreciated, by men of all parties, distinguished for science and general attainments. Germany may boast of a conscientious cultivation of the sciences and of its honorable acknowledgement of the merits of foreigners; but many first rate men have often been thrown back on themselves, or confined to a narrow circle, though capable of imparting valuable information to society, from the want of such a work. . . . No man can find time to hunt after all that he may desire to be informed of, if scattered abroad in numberless periodicals; and few public libraries, much less individuals, have even the means at command to purchase all that are published. And yet the basis of knowledge is wasted, and the capacity to appreciate it greater, in Germany than in the surrounding countries. The German Quarterly is intended to collect together whatever is best and most important in all branches of knowledge, that they may gain general appreciation and be brought home as far as possible to the business and bosoms of men in our everyday life. . . ."

A Life-Saving Rocket Apparatus

THE *Mechanics' Magazine* of April 14, 1838, quoting from the *Silurian*, said: "A Mr. Gyngell made experiments on the Green near Brecon, with some rockets of his invention for communicating with stranded vessels. He discharged several rockets of different weights. The rope was coiled on a cone formed of light rails of wood, and was carried out the distance of from 3 to 5 hundred yards according to the size of the rocket attached to it. . . . Mr. Boyers, of Swansea, in a letter on this subject that we inserted a few weeks since, remarks that if rockets could have been obtained at the time of the wreck of the Killarney steamer, a number of lives might have been saved and the survivors would have been delivered from their dreadful sufferings. . . . It is very seldom that an instance occurs of a vessel striking on a lee shore a greater distance than a quarter of a mile from the land. We need hardly point out the utility of the rocket in such cases, and we hope ere long no vessel will leave port without being provided with this simple and cheap apparatus."

University Events

ABERDEEN.—The honorary degree of LL.D. was conferred on Dr. E. J. Butler, secretary to the Agricultural Research Council, and on Dr. G. Dahlberg, director of the Institute of Medical Genetics, Uppsala, among others, on March 30. The ordinary degree of D.Sc. was conferred on Dr. D. Robertson, for a thesis entitled "Studies on the Internal Parasites of Sheep in Scotland and the Importance of Nutrition in Regard to their Control."

CAMBRIDGE.—The adjudicators consider that the following essays submitted by candidates for the Smith's Prizes and Rayleigh Prizes are of distinction: F. Hoyle, of Emmanuel College, "Beta-Disintegration"; G. L. Clark, of Trinity College, "The Relativity Theory of Gravitation"; G. S. Rushbrooke, of St. John's College, "Strictly-regular Solutions"; A. L. Yoxall, of Sidney Sussex College, "Systems of Equivalence and their Applications to the Geometry of Algebraic Varieties". The Smith's Prizes are awarded to F. Hoyle, of Emmanuel College and A. L. Yoxall, of Sidney Sussex College. Rayleigh Prizes are awarded to G. L. Clark, of Trinity College and G. S. Rushbrooke, of St. John's College.

The General Board recommends: (*a*) that the following additional University teaching offices be established: A University lectureship in the Faculty of Economics and Politics; two University demonstratorships in the Department of Engineering; (*b*) that a third assistant directorship of research in colloid science be established and that the General Board be authorized to appoint Dr. H. W. Melville to this post for five years; (*c*) that a post of assistant in statistical research be established; (*d*) that three posts of assistant in research in medicine be established from July 1, and that appointments to these posts be made by the Appointments Committee of the Faculty of Medicine, with the approval of the General Board, each for a period not exceeding five years, or for so long as the Rockefeller Foundation continues the grant to the University for this purpose, whichever period is the shorter.

The Board of Research Studies has approved Dr. F. P. Bowden, of Gonville and Caius College, for the degree of Sc.D.

LONDON.—Lieut.-Colonel H. E. Shortt has been appointed, as from April 1, to the University readership in medical parasitology tenable at the London School of Hygiene and Tropical Medicine. Since 1934 he has been director of the King Institute of Preventive Medicine, Madras.

Societies and Academies

Paris

Academy of Sciences, February 7 (*C.R.*, 206, 385–464).

GASTON JULIA: The inversion of the linear operators of Hilbertian space.

LUCIEN CAYEUX: The brechoid structure of chalk containing phosphates of the North of France, and its multiple origins.

CHARLES ACHARD, AUGUSTIN BOUTARIC and MME. MADELEINE ROY: Viscosimetric researches on serums and solutions of their proteins separated by the cold acetone method.

PIERRE LEJAY: Application of the inverted elastic pendulum to levelling the axes of astronomical instruments. This method possesses some advantages over the usual liquid level. It is much more rapid and rather more accurate.

HENRI EYRAUD: Some laws of errors in two dimensions.

GUSTAVE MALÉCOT: The Mendelian chances and the correlations of heredity.

STANISLAS GOLAB: The function representing the distance of a variable point to a fixed ensemble.

RODOLPHE HENRI GERMAY: The decomposition into primary factors of certain uniform functions.

DRAGOSLAV S. MITRINIVITCH: Theorems relating to the differential equation of Riccati.

ROBERT BALLIEU: Functions locally univalent in the unit-circle.

CHI-TAI CHUANG: A criterion of quasi-normal family and on Schottky's theorem.

JOSEPH PERES and LUCIEN MALAVARD: Analogical realizations of flow with jet lines.

PIERRE CLERGET and RAYMOND MARCHAL: The working of injection motors and igniting by compression in a rarefied atmosphere. The motor, with double injection, was fitted with mechanical compressor giving an admission pressure of 760 mm. at a height of 2,700 metres. An aeroplane driven by this motor climbed to a height of 7,650 m. without the controls being affected.

GODOFREDO GARCIA and ALFRED ROSENBLATT: Stokes's formula in the theory of gravity.

GLEB WATAGHIN: The theory of neutrinos.

PAUL EHRENFEST: Two negatives of penetrating cosmic rays obtained in the Bellevue magnetic field (10,000–15,000 gauss) and on the existence of a heavy particle.

MATHIEU DOBINE: A possible method of determination of the true adsorption of the solvent and of the dissolved body in concentrated solutions.

GEORGES CARPÉNI: Electrometry and ultra-violet spectrography of rhodizonic acid. Remarks on titration with iodine.

GEORGES WOLF: A method of determining the metals of the alkaline earths. The method is based on the pressure of carbon dioxide obtained by heating a mixture of the three carbonates in a vacuum at temperatures between 630° C. and 840° C.

FERNANDO GONZÁLES NUÑEZ and EMILO FIGUEROA: Preparation and study of vanadyl bromide.

MLLE. YVONNE GARREAU: Some addition compounds of pyrocatechol.

MME. ELISABETH JÉRÉMINE: The lherzolites in the course of serpentinization in the Lorraine Vosges.

FRANÇOIS KRAUT and ANDRÉ VATAN: The origin of the clay rocks of the neighbourhood of Confolens (Charente) attributed to the siderolithic. These clays are not, as has been supposed hitherto, siderolithic sediments, but have been formed where they are found.

ARNOLD BERSIER: The subsidence in the molassic pre-fosse of the Alps.

RENÉ BERNARD: The observation of a new fluorescence phenomenon in the upper atmosphere. The presence and intensity variations of the radiation λ 5893 A. in the light of the sky at twilight.

JACQUES BARDET, ARAKEL TCHAKIRIAN and MLLE. RAYMONDE LAGRANGE: The spectrographic search for traces of elements in sea water. Various precipitates were formed in sea water (60 litres) and examined spectroscopically. By this method all the elements detected by other workers, with the exception of

nickel and tungsten, have been found, and arsenic and gallium, not previously notified, were added to the list. Gold was not found, and there seems reason to suppose that gold is irregularly distributed in sea water.

TIEN KIU: Atmospheric absorption and molecular diffusion according to the measurements of the Smithsonian Institution at Montezuma.

PHILIPPE HAGENE: The influence of the solvent and of the concentration on the velocity of penetration of thymol into the internal epidermal cells of the fleshy leaves of the onion bulb.

ROGER GAUTHERET: Researches on the culture of fragments of tubercles of the carrot.

MAURICE BOUCHET, ANTOINE JULLIEN, DANIEL VINCENT and MLLE. MADELEINE VUILLET: The diffusion of acetylcholine starting with the heart of *Helix pomatia*. In *Helix pomatia* a fraction of the intramyocardiac acetylcholine is diffusible into the surrounding medium: the concentration of the medium in this substance increases with the time, reaching a certain equilibrium after some hours. The quantity set free amounts to approximately one eighth of the total stock of acetylcholine.

ANTOINE MAGNAN, CHARLES PERRILLIAT-BOTONET and HENRY GIRERD: Attempts at simultaneous cinematographic recording in three perpendicular directions, two by two, of the flow of air around a bird in flight.

Prague

Czech Academy of Sciences and Arts

May 28, 1937.

J. MILBAUER: Colloidal and pure carbon. Colloidal carbon was prepared by the action of sulphuric acid on acetylene at 200° C. After centrifuging and washing, purest carbon was obtained, of a brownish black colour. Pure carbon was also obtained by using sugar instead of acetylene.

R. ROST: The minerals in burning waste heaps in the Kladno district.

A. ORLOV: The first discovery of bauxites in Czechoslovakia.

E. KODÍČEK and J. JOACHIM: The quantity of vitamin C in the organs of rats affected by vitaminose B.

T. BUDAY: Geological conditions in the surroundings of Šahy, in southern Slovakia.

October 22, 1937.

K. DOMIN: *Lycopodium Issleri* Rouy in Czechoslovakia and the variability of the native *Lycopodium* of the section *Heterophylla* Spring.

B. HEJDA and F. PROCHÁZKA: Glutathione in the blood, and its significance in metabolism.

F. NĚMEJC: Palæobotanical studies in travertine sediments near Gánoved and Horky (Poprad, Slovakia).

J. WOLF: The surface relief of human skin. (2) Stratum desquamans epidermis in man.

V. ŠPALEK: The Miocene of Židlochovice, Moravia.

December 10, 1937.

J. MILBAUER: A note on the action of permanganate with selenites.

J. VACHTL: A new discovery of carboniferous flora in the Slovakian Ore Mountains.

M. HAMPL: The strain and bending of a spherical bottom, effected by uniform radial pressure.

V. HOVORKA and V. SÝKORA: The β-oxime of isatine, a new reagent for certain metals. (2) Determination of uranium by the β-oxime of isatin.

Washington, D.C.

National Academy of Sciences (*Proc.*, **24**, 53–106, Feb. 15).

W. J. ROBBINS: Organisms requiring vitamin B_1. The fungi examined can be divided into four groups according as they require: (1) the vitamin; (2) thiazole and pyrimidine (intermediates of the vitamin), or the vitamin; (3) pyrimidine, both intermediates or the vitamin; (4) thiazole, both intermediates or the vitamin. Some fungi are unaffected by any of these substances, and others are inhibited.

O. J. EIGSTI: Cytological study of colchicine effects in the induction of polyploidy in plants. Solutions of 1 per cent colchicine and upwards are toxic, and even weaker solutions are toxic if treatment is prolonged. Weak solutions produce enlargement of meristematic tissue (root and stem). Individual cells are affected independently of their neighbours. Mitosis proceeds, but spindle and cell-plate formation are inhibited, producing nuclei with double or more times the number of chromosomes.

G. EVELYN HUTCHINSON: Chemical stratification and lake morphology. The distribution of alkalinity (bicarbonate ion, determined by titration with methyl orange as indicator) in a small lake suggests that the bottom water movements are confined to thin horizontal layers, as suggested by Alsterberg. Certain sudden rises in alkalinity appear to be initiated by temperature minima at the surface.

J. BONNER and D. BONNER: Ascorbic acid and the growth of plant embryos. Embryos of different varieties of peas differ markedly in the amount of ascorbic acid they are able to synthesize from sucrose and also in their response to added ascorbic acid. Varieties which synthesize most respond least (or not at all) to added ascorbic acid, and vice versa.

W. J. V. OSTERHOUT: Potentials in *Halicystis* as affected by non-electrolytes. To study changes in potential difference caused by diluting sea water bathing cells of *Halicystis*, a non-electrolyte should be added to maintain the osmotic pressure of the sea water; mannite seems to be most suitable.

G. W. BEADLE, R. L. ANDERSON and JANE MAXWELL: A comparison of the diffusible substances concerned with eye colour development in *Drosophila*, *Ephestia* and *Habrobracon*.

D. M. WHITAKER: Effect of *p*H on the development of ultra-centrifuged *Fucus* eggs. Fertilized eggs centrifuged at 150,000 times gravity and at *p*H 7·9–8·1 formed rhizoids at the centrifugal ends; at *p*H 5·8–6·1, rhizoids formed at the centripetal ends. The effects may be due to concentration and toxic over-concentration respectively of growth hormone by centrifuging.

LOUISE WIPF and D. C. COOPER: Chromosome numbers in nodules and roots of red clover, common vetch and garden pea. In each species, a tetraploid number (twice that of ordinary tissue) was found.

G. A. MILLER: (1) Groups having a maximum set of independent generators of the same order. (2) Groups having a maximum number set of conjugate independent generators.

R. COURANT: Existence of a minimal surface of least area bounded by prescribed Jordan arcs and prescribed surfaces.

F. BERNSTEIN: The continuumproblem.

H. LEWY: Existence of a closed convex surface realizing a given Riemannian metric.

Forthcoming Events

Tuesday, April 12

QUEKETT MICROSCOPICAL CLUB (at 11 Chandos Street, Cavendish Square, W.1), at 7.30.—Prof. F. J. Cole, F.R.S.: "Microscopic Science in Holland in the Seventeenth Century". (Open to the public.)

Wednesday, April 13

SOCIETY OF GLASS TECHNOLOGY (in the University, Sheffield), at 2.—Annual General Meeting.

FARADAY SOCIETY, April 11–13. General Discussion on "Chemical Reactions involving Solids", to be held in the University of Bristol.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

ASSISTANT ENGINEER in the Roads Department of the Ministry of Transport—The Assistant Secretary, Establishment Department, Ministry of Transport, Metropole Buildings, Northumberland Avenue, W.C.2 (April 11).

CIVILIAN INSTRUCTOR (engineering) for the Royal Army Service Corps Training Centre, Aldershot—The Under-Secretary of State (C.5), War Office, London, S.W.1 (April 11).

SENIOR TECHNICAL OFFICER at the Air Ministry Headquarters, London—The Secretary, Air Ministry (S.2.d), Adastral House, Kingsway, W.C.2 (April 15).

SCIENTIFIC OFFICER in the Air Ministry Research Pool—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants (April 15).

JUNIOR SCIENTIFIC OFFICERS at the Building Research Station, Garston—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (April 19).

JUNIOR SCIENTIFIC OFFICERS at the National Physical Laboratory, Teddington, Middlesex—The Director (April 19).

LECTURER AND ASSISTANT LECTURER IN MECHANICAL ENGINEERING in the Belfast College of Technology—The Director of Education, Victoria Street, Belfast (April 23).

CIVILIAN EDUCATION OFFICER (grade III) in the Royal Air Force Educational Service—The Secretary, Air Ministry (E.S.1.), Adastral House, Kingsway, London, W.C.2 (April 23).

HEAD OF THE CIVIL AND MECHANICAL ENGINEERING DEPARTMENT of the Northampton Polytechnic, St. John Street, London, E.C.1.—The Principal (April 25).

ASSISTANT LECTURER IN STATISTICS in the London School of Economics, Houghton Street, Aldwych, London, W.C.2—The Secretary (April 30).

ASSISTANTS (grades II and III) in the department of War Department Chemist—The Under-Secretary of State (C.5), War Office, Whitehall, London, S.W.1 (April 30).

INSTRUCTOR IN DOMESTIC ENGINEERING in the Education Department of the Straits Settlements—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1.

LECTURER (woman) IN HYGIENE AND BIOLOGY in the Avery Hill Training College—The Education Officer (H.2/1), County Hall, London, S.E.1.

ASSISTANTS (grade III) in the Meterological Office—The Secretary (S.2.A), Air Ministry, Adastral House, Kingsway, W.C.2.

DIRECTOR OF THE NATIONAL INSTITUTE OF POULTRY HUSBANDRY—The Principal, Harper Adams Agricultural College, Newport, Shropshire.

CIVIL ENGINEER in the Public Works Department of the Sudan Government—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1.

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

British Museum (Natural History). John Murray Expedition, 1933-4. Scientific Reports, Vol. 5, No. 5: The Astacura and Palinura. By Dr. M. Ramadan. Pp. 123–146. 2*s.* 6*d.* Scientific Reports, Vol. 5, No. 6: Pycnogonida. By Dr. W. T. Calman. Pp. 147–166. 2*s.* 6*d.* (London: British Museum (Natural History).) [163

Committee of the Privy Council for Medical Research. Report of the Medical Research Council for the Year 1936-7. (Cmd. 5671.) Pp. 195+xiv. (London: H.M. Stationery Office.) 3*s.* net. [183

Report of the Rugby School Natural History Society for the Year 1937. Pp. 67+2 plates. (Rugby: George Over (Rugby), Ltd.) [213

Other Countries

South Australian Department of Mines. Mining Review for the Half-Year ended 30th June, 1937. (No. 66.) Pp. 111+4 plates. (Adelaide: Government Printer.) [183

Lunds Universitets Årsskrift. N.F., Avd. 2, Bd. 33, Nr. 4: Kungl. Fysografiska Sällskapets Handlingar, N.F. Bd. 48, Nr. 4. Meddelande från Lunds Astronomiska Observatorium, Ser. 2, Nr. 90: On an Apparent Connection between Sunspot Frequency, Meteorite Frequency, and the Longitudes and Conjunctions of the Major Planets. By Nils Malmquist. Pp. 23. Lunds Universitets Årsskrift, N.F. Avd. 2, Bd. 34, Nr. 4: Kungl. Fysografiska Sällskapets Handlingar, N.F. Bd. 49, Nr. 4. Meddelande från Lunds Astronomiska Observatorium, Ser. 2, Nr. 86: The Distributions of the Second Moment and of the Correlation Coefficient in Samples from Populations of Type A. By Carl Erik Quensel. Pp. 111. Lunds Universitets Årsskrift, N.F. Avd. 2, Bd. 34, Nr. 7: Kungl. Fysografiska Sällskapets Handlingar, N.F. Bd. 49, Nr. 7. Meddelande från Lunds Astronomiska Observatorium, Ser. 2, Nr. 93: Positions of 75 Stars supposed to be Members of the Taurus Cluster. By Helge Nordström. Pp. 17. (Lund: C. W. K. Gleerup; Leipzig: Otto Harrassowitz.) 1 kr.

Meddelande från Lunds Astronomiska Observatorium. Ser. 2, Nr. 91: Historical Notes and Papers, Nr. 12: On the Historical Origins of Atomism. By Per Collinder. Pp. 8. Ser. 2, Nr. 92: Invisible Companions of Parallax Stars revealed by means of Modern Trigonometric Parallax Observations. By Erik Holmberg. Pp. 23+1 plate. (Lund: C. W. K. Gleerup.) [163

U.S. Department of the Interior: Geological Survey. Water-Supply Paper 778: Geology and Ground-Water Resources of Webb County, Texas. By John T. Lonsdale and James R. Day. Pp. v+104+12 plates. 30 cents. Water-Supply Paper 796 C.: Flood in La Cañada Valley, California, January 1, 1934. By Harold C. Troxell and John Q. Peterson. Pp. iv+53–98+19 plates. 20 cents. Water-Supply Paper 797: Selected Bibliography on Erosion and Silt Movement. By Gordon R. Williams and others. Pp. 91. 15 cents. Water-Supply Paper 904: Surface Water Supply of the United States, 1936. Part 4: St. Lawrence River Basin. Pp. 160. 25 cents. Water-Supply Paper 808: Surface Water Supply of the United States, 1936. Part 8: Western Gulf of Mexico Basins. Pp. 262. 35 cents. Water-Supply Paper 809: Surface Water Supply of the United States, 1936. Part 9: Colorado River Basin. Pp. 187. 30 cents. Water-Supply Paper 812: Surface Water Supply of the United States, 1936. Part 12: Pacific Slope Basins in Washington and Upper Columbia River Basins. Pp. 161. 25 cents. Water-Supply Paper 813: Surface Water Supply of the United States, 1936. Part 13: Snake River Basin. Pp. 242. 35 cents. (Washington, D.C.: Government Printing Office.) [163

Proceedings of the Fourth International Locust Conference, Cairo, April 22, 1936. Pp. ix+51 papers+4 plates. (Cairo: Government Press.) [183

U.S. Department of the Interior: Geological Survey. Bulletin 880-D: The Eska Creek Coal Deposits, Matanuska Valley, Alaska. By Ralph Tuck. Pp. ii+185–213. 35 cents. Bulletin 895-A: Geophysical Abstracts 88, January–March, 1937. Compiled by W. Ayvazoglou. Pp. ii+42. 10 cents. (Washington, D.C.: Government Printing Office.) [213

Proceedings of the American Academy of Arts and Sciences. Vol. 72, No. 3: An Experimental Study of the Absolute Temperature Scale. 5: The Reproducibility of the Ice Point and the Triple Point of Water; The Temperature of the Triple Point of Water. By James A. Beattie, Tzu-Ching Huang and Manson Benedict. Pp. 136–155. 50 cents. Vol. 72, No. 4: The Resistance of Nineteen Metals to 30,000 Kg./Cm.². By P. W. Bridgman. Pp. 156–205. 90 cents. Vol. 72, No. 5: Rough Compressibilities of Fourteen Substances to 45,000 Kg./Cm.². By P. W. Bridgman. Pp. 206–225. 40 cents. Vol. 72, No. 6: Polymorphic Transitions up to 50,000 Kg./Cm.² of Several Organic Substances. By P. W. Bridgman. Pp. 226–268. 80 cents. (Boston: American Academy of Arts and Sciences.) [213

Field Experiments on Sugar-Cane in Trinidad: Annual Report for 1937. By P. E. Turner. Pp. 95. (Trinidad: Sugar-Cane Investigation Committee.) [213

U.S. Department of Agriculture. Leaflet No. 145: Clothes Moths. By E. A. Back. Pp. 8. (Washington, D.C.: Government Printing Office.) 5 cents. [213

University of Illinois: Engineering Experiment Station. Bulletin No. 299: Solution of Electrical Networks by Successive Approximations. By Laurence L. Smith. Pp. 40. (Urbana: University of Illinois.) 45 cents. [213

Det. Kgl. Danske Videnskabernes Selskab. Mathematisk-fysiske Meddelelser, 15, 6: Hg-Dynamics 1: Theory of the Laminar Flow of an Electrically Conductive Liquid in a Homogeneous Magnetic Field. By Prof. Jul. Hartmann. Pp. 28. 1.50 kr. Hg-Dynamics 2: Experimental Investigations on the Flow of Mercury in a Homogeneous Magnetic Field. By Prof. Jul. Hartmann and Freimut Lazarus. Pp. 45. 2.50 kr. (Copenhagen: Levin and Munksgaard.) [213

Department of Natural Resources, Newfoundland: Division of Fishery Research. Annual Report of Fishery Research Laboratory, 1936–37. Pp. 49. (St. Johns, Newfoundland: Department of Natural Resources.) 25 cents. [213

Memoirs of the Geological Survey of India. Vol. 72, Part 1: The Geology of Parts of the Minbu, Pakokku and Lower Chindwin Districts, Burma. By Dr. G. de P. Cotter. Pp. xxi+136+xl+11 plates. (Delhi: Manager of Publications.) 5.12 rupees; 9*s.* 6*d.* [213

Catalogues, etc.

Catalogue of Second-hand Scientific Books mainly from the Library of Dr. J. W. Mellor, D.Sc., F.R.S., including an Important Collection of Transactions of Learned Societies and Scientific Journals. (Catalogue No. 44.) Pp. 68. (London: Harrods Scientific Book Department.)

Rare Africana, 1938. (Catalogue No. 625.) Pp. 37+1 plate. (London: Francis Edwards, Ltd.)